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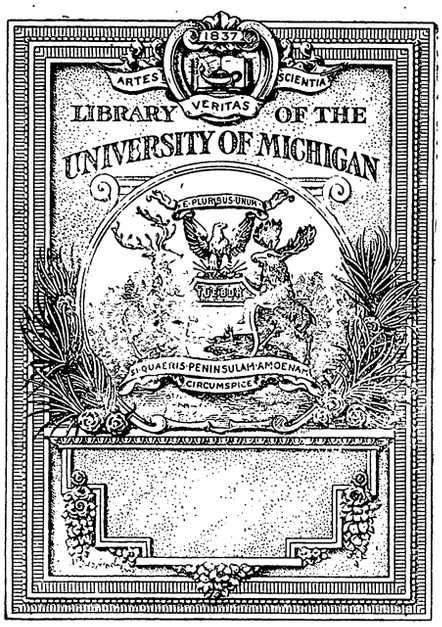

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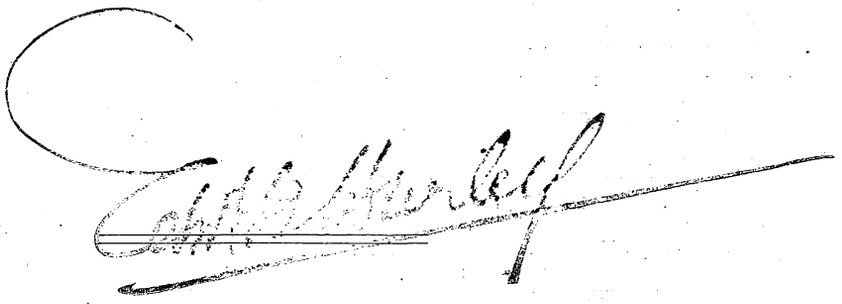
A WEEKLY JOURNAL OF

THEORETICAL AND APPLIED ELECTRICITY AND CHEMICAL PHYSICS.



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THE ELECTRICIAN:

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THEORETICAL AND APPLIED ELECTRICITY AND CHEMICAL PHYSICS.

No. 1.—Vol. V. SATURDAY, MAY 22, 1880. Price 4d.

SLIP

The Brush Light.—We understand that the Brush Electric Light Company has received an order for nearly £20,000 worth of machines and lamps from Her Majesty's Government.

The Society of Telegraph Engineers.—The next meeting will be held at the Institution of Civil Engineers, 25, Great George-street, Westminster, S.W., on Wednesday, May 26th, 1880, when a paper will be read on "A Decade in the History of English Telegraphy," by Edward Graves.

Telephone Interests in America.—We are glad to see that telephonic work is in future to be carried on amicably. The Articles of Consolidation of the Bell Telephone Company at New York and the Gold and Stock Telegraph Company were signed on April 8, and the name of the new company will probably be the Metropolitan Bell Telephone Company.

Telephone Central Office Switch Board.—A patent has been taken out in America by Mr. T. C. Ellsworth for an improved switch board. The new board is provided with a number of longitudinal bars by which the wires of the different subscribers are connected. In use these bars are turned to indicate they are occupied, allowing the attendant to see at a glance which circuits are in use.

Teaching Students.—A crusade is being carried on in America against teaching manipulation. The operators seem to think that if they decline to teach there will be less danger of being superseded. Perhaps so; but we have found that any profession with vacancies worth the attention of the forthcoming generation are, sooner or later, filled by capable men. If the operators decide not to teach, we shall find schools of telegraphy springing up in America as in England and in France.

Business at Birmingham.—As a rule the houses engaged in the plating trade are not very busy. In certain branches, forks and spoons for instance, there is plenty of work doing, but nothing further. We do not underrate the keen sightedness of many of our most eminent houses, but we do think there is an insufficient indication of progress. New methods and new ideas do not find favour, and it frequently rests with our American competitors to lead the way, while we hesitate to follow.

The Telephone.—The telephone is now being brought into use in the various Government establishments at Chatham. Eight have been fitted up at the School of Military Engineering; and the Pembroke, flagship of Admiral Superintendent T. Brandreth, which is moored in the large basin at the dockyard extension, is to be brought into communication with the Medway Steam Reserve Office in the dockyard, a distance of about a mile and a quarter. The instruments in use are the Gowar-Bell telephones.

Globular Lightning.—As any occurrence involving this form of electricity is of particular interest in certain quarters, we reproduce the following from the *Echo*:—"A very extraordinary occurrence is reported from Rochdale. It is declared that a violent explosion took place in the shop of Mr. Stevenson, druggist. It blew out the shop and house windows, and did other damage. Just before the explosion a ball of fire was seen coming through the skylight, and it is believed that the whole mischief was caused by lightning."

New Coupling for Lightning-Conductors.—The connection between the upper portion of a lightning conductor and that most essential portion through which the earth-contact is made is frequently, and sometimes more or less unaccountably, found to be broken when it has been made either by rivetting or soldering. We are therefore glad to notice that Messrs. Cutting and Co., of 147, Queen Victoria-street, have brought out a new coupling involving neither of these expedients, and which, though specially devised for their own tape conductors, is applicable also to wires, ropes, or rods. In this contrivance the earth connection is passed through two slots in a screw plug, which, by means of a screw-nut, brings the two portions of the conductor into close contact in such manner as to avoid any possibility of disconnection.

The Electric Light on Board Ship.—The use of the electric light on ship-board, both as a means of interior illumination and for the prevention of accidents at night and during foggy weather, is, says the *Operator*, steadily on the increase. The Sound steamers Massachusetts and Rhode Island, of the Providence line, have recently been fitted up with Brush lights, by which the halls, cabins, and dining saloons are lighted by electricity. The contract includes an electric head-light, which it is expected will prove extremely valuable in foggy and stormy weather. An exhibition of the use of the new light was given last week on board the steamer Massachusetts. Six lights were used, each light being nominally of 2,000 candle-power, and although the saloons were nearly as brilliant as in the daytime, the light was soft and pleasant to the eye. The comparative cost of this light is about equal to that of gas at 30 cents per 1,000 feet.

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A Hint.—J. H. B. writes to an American contemporary :—Instead of using oil in battery cells I use tallow, which I think much cleaner and better adapted to the purpose. The tallow should be melted, not sizzling hot, but just enough to liquify it. A sufficient quantity to form a crust half an inch thick over the surface should be poured into each jar. As tallow hardens immediately upon coming in contact with water, the jar is at once sealed up with a substance easily procured, easily handled, and, if necessary, easily removed. A pound of tallow, costing five or six cents., will seal up half a dozen jars, and when sealed up in this way they will require very little attention. If it be necessary at any time to add sulphate of copper it can be introduced by merely making a small hole in the crust, which is easily filled up with a little melted tallow. A cell should not be thus sealed up except when in good condition —work it up to its proper stage, then seal it. One great advantage in thus sealing the cell is that it keeps the edge and sides of the jars clear of the crystallisation which is so annoying, and keeps them clean and nice. I set my local cells alongside my instruments since they have been sealed up, and find them not at all objectionable. Mutton tallow is preferable, but beef tallow will do nearly as well. Of course the cell must have sufficient water to allow of the formation of the crust without its touching the zinc.

The Submarine Telegraph Company's Buildings.—The new building intended for the offices of the Submarine Telegraph Company, now almost completed, is situated at the corner of Throgmorton-avenue and London-wall. The area is about 4,100 feet, and the ground is held on lease from the Carpenters' Company. The frontage to London-wall is 50 feet in length, and the other in Throgmorton-avenue 82 feet long. The building is carried to a height of upwards of 80 feet, and contains four storeys and dormers in addition to the ground floor. The two elevations are entirely in Portland stone, with a large quantity of carving. The windows of the fourth floor form one of the most prominent objects in the two elevations, over the central portion of each window being allegorical figure-heads. The sculpture in the Throgmorton-avenue frontage is representative of the company's objects, and consists of colossal medallion figure-heads, enclosed within recessed circles. A medallion of the Queen is on the ground floor, as representing England; on the first floor, another medallion figure-head, representing Europe; on the second floor, Asia; the third, Africa; and the fourth, America; thus typifying the different quarters of the globe. The whole of the building, with the exception of two shops on the ground floor of the London-wall frontage, is intended to be devoted to the conduct of the company's business, the entrances being in Throgmorton-avenue. Mr. Norton, of Bond-street, is the architect of the building, and Messrs. Peto Bros. the contractors. The cost will be from £35,000 to £40,000.

Galvanic Experiments.—The *Journal of the Chemical Society* says of some experiments made by M. E. Dreschsel, that the method employed is to continuously and rapidly reverse the galvanic current from platinum poles through the solution operated upon. By acting in this manner on commercial ammonium carbonate (containing ammonium carbonate) for a period of eight hours, and then evaporating on the water bath, a salt crystallising in fine white needles was obtained. It was found to contain 64·69 per cent. platinum, and is the salt of a platinum base; its composition could not be satisfactorily settled on account of want of material. Concentrated hydrochloric acid gives a bright green, nitric acid a sky blue crystalline precipitate with its solution. About 0·1 grain platinum was dissolved in ten hours by the ammonium carbonate. On working the commutator more slowly, the temperature of the liquid rises, and no precipitate is formed, but by simultaneous cooling a crystalline precipitate occurs, which contains 38·6 per cent. platinum, and is also the salt of a platinum base; this yields no bright green precipitate, but an almost colourless one with hydrochloric acid, consisting of microscopic needles. By operating on a solution of glucose, mixed with sodium phosphate, with very large platinum electrodes, prevented from touching each other by a sheet of filter-paper, the places on the platinum where the paper had rested were found at the end of the experiment to be covered with a brownish translucent substance, easily removable in large plates; this on ignition left a large amount of platinum, but its properties have not as yet been investigated. H. Rolbe remarks in a note to the paper that these interesting results have induced him to extend his earlier galvanic experiments, and to study the action of rapid change of poles on a number of salts.

Gravitation and Electricity.—Writing prior to 1849, Mrs. Somerville thus states the hypothesis of Mossotti :—As the particles of material bodies are not in actual contact, Professor Mossotti supposes that each is encompassed by an atmosphere of the etherial fluid; that the atoms of the fluid repel one another; that the molecules of matter repel one another, but with less intensity; and that there is a mutual attraction between the particles of matter and the atoms of the fluid—forces which we know to exist and which he assumes to vary inversely as the squares of the distance. The following important results have been obtained by the professor from the adjustment of these three forces :—When the material molecules of a body are inappreciably near to one another, they mutually repel each other with a force which diminishes rapidly as the infinitely small distance between the material molecules augments, and at last vanishes. When the molecules are still farther apart, the force becomes attractive. At that particular point where the change takes place, the forces of attraction and repulsion balance each other, so that the molecules of a body are neither disposed to approach nor recede, but remain *in equilibrio*. If we try to press them nearer, the repulsive force resists the attempt; and if we endeavour to break the body so as to tear the particles asunder, the attractive force predominates and keeps them together. This is what constitutes the cohesive force, or force of aggregation, by which the molecules of all substances are united. The limits of the distance at which the negative action becomes positive vary according to the temperature and nature of the molecules, and determines whether the body which they form be solid, liquid or aëriform. Beyond this neutral point the attractive force increases as the distance between the molecules augments till it obtains a maximum; when the particles are more apart it diminishes; and, as soon as they are separated by finite or sensible distances, it varies directly as their mass and inversely as the square of the distance, which is precisely the law of universal gravitation. Thus on the hypothesis that mutual repulsion between electric atoms is more powerful than mutual repulsion between particles of matter, the ether and the matter attract each other unequally, which leaves an excess of force constituting gravitation.

Paris.—Three systems of improved lighting, says the *Times'* correspondent, have for some time been on trial in Paris, and a fourth, the Werdermann incandescent apparatus, will take part in the impending competition inside the Opera; but this last is said to be of insufficient intensity. As to its rivals, the "intensitive" gas lamps light up the Rue du 4 Septembre, and the Jablochkoff electric light is exhibited in the adjoining Avenue de l'Opéra; but the Lontin system can

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only be seen at the goods station of the Lyons and Mediterranean Railway, the tradesmen of the Rue de la Paix objecting to its installation in that street, on the ground that it would either destroy the effect of their shop lamps, or oblige them to incur the expense and heat of "intensitive" gas jets. Although, however, only two of the systems are at work in immediate contiguity, the merits of all three may easily be compared. The gas company has proved, by the Rue du 4 Septembre, that circles of six burners, with improved ventilation, can equal the electric light in brilliancy, provided the lamp-posts are only twenty or thirty yards apart; but the cost is considerable, and the heat and impurity of air would preclude the adoption of this plan inside any building. The Jablochkoff candles are subject to certain drawbacks—viz., waste of illuminating power through the opal shades necessary to protect the eyes and conceal the unequal height of a range of candles caused by various rates of combustion, variations in brilliancy and colour, the interdependence of the various lamps, and the need of attention by a skilled overseer every two hours. The Lontin system has been in operation all the winter, at the Lyons Station, but has not yet attracted general notice, because installed in an outlying quarter of the city, and at present in the hands of a private firm. I was invited the other night to visit M. Lontin's works in the Boulevard Mont Parnasse, and can only speak in the most favourable terms of what I saw. The light is perfectly steady, and I was assured that it burns all night through without attention, or even for thirty hours, the regulator devised by M. de Mersanne securing the even motion of the carbons. An accident to one lamp does not affect the others, and is signalled by the ringing of a bell, the steam-power being also automatically adjusted to the number of lamps in use. Without entering into the technicalities of the Lontin-Mersanne system, it may safely be described as a formidable rival to the Jablochkoff, and M. Garnier's competitive experiments at the Opera next month are looked forward to with interest.

The Effect of Lightning on Trees.—The Geneva correspondent of *The Times* writes, under date May 12:—"A few days ago, during a violent thunderstorm, a tall poplar on the Cour de Rive, a street in the upper part of Geneva, was struck by lightning. Directly after the occurrence Professor Colladon, the eminent physicist, and one of the consulting engineers of the St. Gothard Railway, made a minute examination of the tree, and his observations, more especially as they are opposed to some generally received theories, and relate incidentally to the right construction of lightning conductors, may be not uninteresting to many of your readers. After remarking that his conclusions are based on the careful investigation of sundry similar phenomena, the professor goes on to say that it is not true, as has been commonly supposed, that the gashes (*plaies*) found in the trunk of a tree which has been struck by the electric fluid are the parts with which the lightning first came into contact. The parts first struck are the highest branches, especially those most exposed to the rain. Thence it runs down the smaller branches—affecting almost the whole of them—to the larger ones until it reaches the trunk. These large branches, and, above all, the trunk, being much worse conductors than the small branches, the passage through them of the fluid produces heat and "repulsive effects" whereby the bark and sometimes the wood are torn in pieces, the bits being thrown a considerable distance, occasionally more than 50 mètres. This theory, says Professor Colladon, is the result of numerous observations. It not infrequently happens that the upper branches and their leaves are destroyed —this is generally the case with oaks, which are often struck —but the leaves and young shoots of poplars and many other trees are such excellent conductors that they do not appear when struck to suffer any notable injury. This rule is so general that, though their trunks may be rent and their bark torn off, not more than two or three poplars out of 100 struck by lightning have their leaves shrivelled or even discoloured. This induction finds full confirmation in the condition of the poplar on the Cour de Rive, for it is not often in Switzerland that trees are struck by lightning early in May, when their leaves are young and tender. In this instance the principal and highest branch of the tree, on its south-western side, was the first with which the fluid came in contact. Its leaves and twigs, neither withered nor tarnished, were torn into minute fragments and scattered about on the ground. This was the effect, not of the lightning, but of the concussion of air, exactly as if there had been an explosion of dynamite or gunpowder; and the windows of two houses close by were broken in the same manner and by the same cause. Before even the professor saw the tree he had expected to find not far from it a spring or a stream of water; for the presence of water near the root of a tree is often the determining cause of its attraction for the electric fluid. In effect the professor found, five mètres from the poplar, on its north side, a leaden water-pipe, and close to it a drain filled with waste water from a laundry. The principal fissure in the tree was also on the north side; and halfway between it and the water-pipe a plank lying on the ground had been pierced by a concentrated jet of the electric fluid as it flashed towards the pipe by the shortest route. Many trees, especially poplars, may be compared to buildings the lightning conductors of which are not continued to the ground. A building of this sort, if struck by the electric fluid, would in all probability remain intact in its upper part and be seriously damaged beneath the part where the conductor ceased. Hence by far the safest part of a tree during a thunderstorm would be its topmost branches. This explains why birds are so rarely killed and their nests so seldom disturbed by lightning, while persons who have sought shelter under the spreading branches of trees are so often struck. The electric fluid, finding the trunk and the larger branches imperfect conductors, is easily attracted by surrounding bodies, whether they be bushes or human bodies. Large trees, especially tall poplars, placed near a house may serve as very efficient lightning conductors, but always on the indispensable condition that there is no well or running water on the opposite side of the house, for in that case the electric fluid, if it struck the tree, might pass through the building on its way to the water. In 1864 a house at Lancy, almost in contact with a poplar on one side and a marsh on the other, was set on fire by lightning, and the path of the electric fluid, from the point at which it left the tree, across the roof of the building to the marsh, could be distinctly traced. Hence, in erecting lightning conductors it is desirable that their lower extremities should terminate in a stream, a well, or a piece of damp ground. The plant most sensible to electricity is the vine. When a stroke of lightning falls in a vineyard the leaves affected are turned red-brown or deep green, a circumstance which shows, in the opinion of Professor Colladon, that the electric fluid descends in a sheet or shower, and not in a single point, the number of vines touched — sometimes several hundred—by a single *coup*, proving that the lightning has covered a wide area. This fact lends additional confirmation to the theory that lightning disperses itself among the smaller branches of trees and over ground covered by vegetation."

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REPORT.

Day by day electricity becomes a more important factor than before in the civilisation of the world. There are phases in its progress which hardly come within the grasp of scientific criticism, but yet are interesting to numbers who are, by some means or other, connected with the pure or applied science. The scientific reader may turn to our other columns; we shall not here cater for him. It is sometimes difficult to make a readable column in a scientific paper for the non-scientific reader, but we hope some readers may, sooner or later, say :—

> In all thy humours, whether grave or mellow,
> Thou'rt such a touchy, testy, pleasing fellow,
> Hast so much wit and mirth, and spleen about thee,
> There is no living with thee, nor without thee.

The grammarians may look forward to a lively time. We shall probably have the usual influx of hybrid terms to designate the result as signal-sending, voice-sending, light-sending appliances are perfected; tele-gram, phono-gram, and another gram; but the question arises, where are the grams to end? However, the telephone companies seem to make sure of a future. In America circuits are being put up in almost every village, and we may soon hear that every backwood shanty is provided with telephonic communication with the centres of civilisation. Bravo. We in England take things a little more coolly, but progress may be reported. The Government are now introducing the apparatus into their offices. Chatham is in luck. Here they have connected the flagship with the Medway Steam Reserve Office, a mile and a quarter away.

By the bye, speaking of dockyards we are reminded that the cable companies boast of a magnificent fleet of ships. The Eastern Company reports the John Pender at Suez, the Great Northern at Zanzibar, the Retriever at Syra, and the Chiltern at London. The Eastern Extension Company report the Sherard Osborne at Singapore, and the Agnes at Sydney. The Telegraph Construction and Maintenance Company's ss. Calabria is still in Chinese waters, having recently completed the laying of the Hong-Kong-Manilla cable, which, as we have before reported, is working satisfactorily. The Scotia, Seine, and Kangaroo are in the Thames, being the ships selected to take on board the new Atlantic cable for the Anglo-American Company. The Scotia will ultimately take the deep sea section of this cable, while the Seine and Kangaroo will have on board the Placentia, St. Pierre, and Sydney sections of the cable. It might have been mentioned above that the Chiltern is taking on board some new cable for the Vigo-Lisbon section of the Eastern Company's system. We believe the Faraday has sailed to repair the fault which has been notified as being found in the New French Atlantic cable.

Passing from water to land we notice that the Submarine Telegraph Company's new buildings, at the corner of Throgmorton-street, are almost completed. What a comfort it would be if, in the midst of progress, some of our large companies would consider the human machine. Did any one ever visit the City and make half a dozen calls without anathematising all the "stairs" in creation?

The season of the societies is drawing to a close, but before the end of the session Dr. Siemens is to have an evening at the Society of Telegraph Engineers. Whenever this happens the members will have a treat, for Dr. Siemens is one of the most careful workers we have, and will not publish results till he is pretty sure they are correct. Floriculturists should hasten to secure tickets.

Mr. Upton, in the columns of the *Scientific American*, relies upon the report of Messrs. Brackett and Young to prove that Edison's dynamo machine is better than the Siemens. *Nous verrons.*

It is not customary in England to write much about individuals, but the members of the Society of Telegraph Engineers undoubtedly owe a debt of gratitude, if not something felt to be of a much more substantial nature, to the acting librarian, Mr. A. J. Frost, for having so admirably carried out the compilation of the Ronalds Catalogue. We might suggest to the members that as some books mentioned in the Catalogue are not in the Library an effort might be made to complete the library by donations of the missing volumes.

Suggestions do not occur singly. The Agricultural Hall has been used for exhibition of "building material," &c., why does not some enterprising caterer get up an exhibition of electrical apparatus? We shall hear more of this suggestion.

ON THE ECONOMIC DUTY OF ELECTRIC MOTORS,

And the Measurement of the Quantity of Energy Traversing an Electric Circuit.

BY M. MARCEL DEPREZ.

[Translated from the *Comptes Rendus.*]

When a motor is inserted in the circuit of a battery, the intensity of the current differs when the motor is inactive and when it moves with the production of a certain quantity of work. Let I be the current when the motor is at rest, and i the current when it is in action. After measuring these two values let us stop the motor and introduce in the circuit a resistance such as will reduce the current from I to i. Under these conditions the production of energy by the battery is evidently the same as when the motor was at work; since the electromotive force and the current are the same. Moreover the expenditure of energy evidently has not varied in that portion of the circuit external to the motor and to the additional resistance. We are therefore justified in stating that, in regard to expenditure of energy, the motor in action on the one hand, and the motor at rest, with the additional resistance, on the other hand, are precisely equivalent.

Now the quantity of energy absorbed in a simple resistance and converted into heat, in unit time is expressed by the product of the resistance into the square of the intensity of the current.

Calling r_1 the resistance of the motor at rest, r_2 the additional resistance necessary to reduce the current to the intensity i, and Q the quantity of heat evolved in these two resistances, we have

$$Q = (r_1 + r_2)\, i^2.$$

In accordance with what precedes, this is also the quantity of energy manifested as heat and work, absorbed by the motor when it is in action. Calling T the work here referred to, we have

$$T + r_1 i^2 = (r_1 + r_2)\, i^2, \text{ or } T = r_2 i^2.$$

Comparing this portion of energy converted into useful work with the total quantity absorbed by the motor, we obtain an expression for the duty:—

$$\frac{T}{Q} = \frac{r_2}{r_1 + r_2}.$$

This very simple expression may be replaced by another, which is of great importance in the case where the current is produced by a dynamo-electric machine. Let us call E_1 the electromotive force of the generating machine and E the opposing E M F of the receiving machine, which, by the effect of its rotation, tends to generate a current in the direction contrary to that of the working current. The current traversing the two machines is due to the difference $E_1 - E$; and if we call R the sum of the *static** resistances of the two machines and of the external circuit it will be expressed by

$$I = \frac{E_1 - E}{R}.$$

Let us now find the value of the resistance r_2, which must be added in the circuit in order that the current traversing it may still have the intensity I, when the rotation of the receiving machine is arrested. This is obtained from the equation

$$\frac{E_1 - E}{R} = \frac{E_1}{R + r_2},$$

whence

$$r_2 = \frac{E_1 R}{E_1 - E}.$$

The value of the absolute economic duty of the receiving machine will be equal, in accordance with the preceding theorem to $\frac{r_2}{r_1 + r_2}$, in which the total resistance, R, of the whole circuit should be substituted for r_1.

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* [The author explains in a foot note that he means by this the resistance of the machines in a state of rest. We should prefer the expression "wire resistance," or simply "resistance;" since at a given temperature the resistance, properly speaking, is constant, and quite independent of any opposing E.M.F.—Ed. *E.*]

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This duty, which is simply the ratio of the work transmitted to the work expended, then becomes, r_2 being replaced by its value,

$$\frac{E}{E_{,}},$$

a remarkable expression, which is independent of the resistance of the external circuit.* This fact may at first sight seem extraordinary, and even contradictory to certain experiments in which perhaps sufficient care was not taken to realise the conditions of maximum duty. It becomes less paradoxical when it is remembered that whenever a current is employed to develop energy in a form other than mechanical work, for instance, to produce the decomposition of water in a voltameter, the number of equivalents of water decomposed is always equal to the number of equivalents of zinc dissolved in each of the elements of the battery, whatever may be the length of the external circuit. The latter, moreover, does not affect the number of elements necessary to produce this decomposition. We have therefore a well-verified experimental fact in which the economic duty is not influenced by the external circuit.

I pass now to the description of the apparatus allowing of the measurement of the quantity of energy passing during unit time electric circuit included between two points, A and B.

Let us unite these two points through an auxiliary (derived) circuit of high resistance, in which is inserted a galvanomter coiled with a long and fine wire, whilst another constructed with a short and thick wire is placed in the main circuit. This being understood, let us endeavour to find the expression for the quantity of energy passing in the principal circuit in terms of the intensities of these two currents, measured by the deviations of the galvanometer needles.†

Let us call I and R the intensity and the resistance of the main circuit, I and $R_{,}$ the corresponding values for the derived circuit. Let E be the difference of the potentials at A and B. The quantity of energy passing in the main circuit is expressed by RI^2 or EI; whilst the intensity of the current in the derived circuit is

$$\frac{E}{R_{,}} = I_{,},$$

whence

$$E = R_{,} I_{,},$$

and, consequently,

$$E I = R_{,} I I_{,}.$$

The quantity of energy is therefore proportional to the product of the intensities of the two currents, or to the product of the deviations of the needles.

An instrument may be constructed which will indicate at any time the value of this product.

GREAT NORTHERN TELEGRAPH COMPANY OF COPENHAGEN.

Abridged Report of the Annual General Meeting held at Copenhagen on the 24th April, 1880.—F. Zahle, Esq., presided.

The chairman, C. F. Tietgen, Esq., in reporting upon the Company's business generally, was glad to be able to say that the result of the past year's working had been very good; in fact, it had been the most favourable ever attained since the existence of the Company, and this notwithstanding difficulties which the directors had had to contend with.

State of the Cables.—The difficulties referred to above mainly consisted in the interruptions of the cables. In the far East the cables had not suffered so much in this respect as in former years, and as the company had their own repairing steamer in those waters, the repairs had been effected very speedily, in fact the average of the interruptions had only been four days. In Europe, on the contrary, the cables had been damaged more frequently than in former years. The cause of these interruptions had been the same as usual, viz., breakages caused by ships' anchors and by trawlers.

New Repairing Ship.—Hitherto the company had, in order to restore these cables, been obliged to rely upon the use of ordinary steamers temporarily fitted up for the purpose, but as this was not only very costly, but gave rise to much loss of time, the directors had decided that the company should acquire a ship of their own, specially built and supplied with all the latest improvements for this purpose. This cable steamer had been ordered of the Burmeister and Wain Company, at Copenhagen, the builders of the company's repairing ship in the far East, the H. C. Oersted, which had given satisfaction in every respect. The new ship would be somewhat larger than the latter, and would be completed by the end of June next. The cost of the ship with full equipment, cable machinery, instruments, &c., would be about £22,000. Instead of investing the whole sum appropriated for the reserve fund, the above amount had been retained in cash in order to pay for the ship. Once in possession of that ship, the repairs would in future be effected at a considerably smaller cost than hitherto, and as a great saving in time would be gained an increase in the traffic receipts would naturally follow.

Traffic.—In 1879 the receipts had, according to the traffic returns, been 5,195,168 francs, as compared with 5,087,816 francs in 1878, showing an increase of more than 100,000 francs. This increase was mainly attributable to the improvement in the traffic during the latter months of the past year, when a revival of trade first became apparent. During the early months of this year the same improvement has steadily manifested itself. It would be remembered that at the St. Petersburg Conference in 1875 the *word rate* was introduced for all extra-European traffic, and the results of the working of that system being satisfactory, it had been decided at the London Conference last year to extend it to the European traffic. There could be no doubt that by degrees the new rule would be appreciated by the general public, as messages containing as few as three words might now be transmitted at a very low charge, whereas formerly the lowest charge was made up for 20 words however short the message might be. It was, after the short experience since the 1st April, impossible to say what the exact practical result would be for the company; but considering that the very important traffic between Great Britain, Russia, and the Scandinavian countries which passed over the company's lines related principally to mercantile and shipping interests, there were reasonable prospects of a further increase in the amount of the general traffic passing over the company's lines. Having regard to the present and the prospective augmentation of the traffic, and also to the fact that trawl fishing in the North Sea was fast increasing, in consequence of which the cables would be more liable to be damaged than formerly, it would be necessary to be prepared with the means to maintain an efficient service on all the company's cable routes. The directors had therefore now under consideration the advisability of laying another cable from Great Britain to the Scandinavian countries. The question of how to carry out this intention in the most practical manner would to some extent depend upon the result of negotiations which would now be carried on with the different Governments. The reserve fund would suffice for the expense incurred by this addition to the number of the company's cables, but it would perhaps be more expedient not to absorb that fund, and instead thereof to obtain the required capital by the issue of 5 per cent. Debentures, which might now easily be placed at par, and the interest of which would not form a heavy charge upon the company's revenue. The directors would, however, when the proper time arrived, not fail to submit this question to the shareholders at an extraordinary general meeting.

Referring to general matters, the Chairman further reported:

Share Certificates.—The exchange of share warrants of £100 against an equivalent amount of warrants of £10 each, referred to at the last meeting, had been effected, and the capital of the company was now divided in 11,000 A share warrants of £100 each, and 40,000 B share warrants of £10 each.

Working Account.—It would be seen from the accounts that the gross receipts for the year 1879 had, including a balance of £14,837 0s. 11d. brought forward from 1878, amounted to £222,493 12s. 5d., whereas the total expenses had been £63,970 0s. 4d., leaving a net revenue balance of £158,523 12s. 1d.; out of this the interim dividend, at the rate of 5 per cent. per annum already paid, absorbed £75,000. It was now proposed to deal with the remaining £83,523 12s. 1d. as follows:—To reserve and renewal fund, £44,444 8s. 10d.; contribution to the pension fund of the staff, £503 9s. 3d.; remuneration to the directors, £1,500; extra dividend on 150,000 shares at the same rate as last year (2s. 9d.), £20,833 6s. 8d.; balance to be carried forward to next account, £16,242 7s. 4d.

Reserve Fund.—Out of the amount referred to above, Kr. 350,000 4 per cent. Royal Danish Bonds, equal to £18,375, had been invested. The remainder had been retained in cash to meet the expenses of the new repairing ship.

The accounts were then passed, and discharge given to the directors.

The retiring director, L. P. Holmblad, Esq., was unanimously re-elected.

Admiral Bille, and A. Berner, Esq., were unanimously re-elected as shareholders auditors.

* This expression for the duty has already been given by M. Cabanellas.

† The author will shortly describe a new galvanometer, giving rapid indications, in which the deflections are proportionate to the currents.

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THE INSULATION OF UNDERGROUND AND SUBMARINE WIRES.

In spite of the perfection to which gutta percha as an insulator has been brought, something is yet wanted to fulfil all that is required for the insulation of underground and submarine lines. The electrical resistance of gutta percha, though not nearly so high as that of india rubber, is still, perhaps, quite sufficient for all practical purposes, and has been improved from about ten megohms per nautical mile at 75° to about fifteen hundred. Its inductive capacity has also been reduced, by increased mastication, from 0·35 microfarads, to about 0·25 microfarads per nautical mile in wire of 107lb. copper and 160lb. gutta percha. It appears, moreover, to remain chemically and electrically unchanged when kept under water. On the other hand, it is rendered plastic at a temperature of about 100, and thus in tropical climes necessitates care even for submarine purposes, as spare cable must be kept from lying for any time in the sun, though the coating of hemp and asphalte now used over the iron wires will, no doubt, allow of exposure a little longer than with the bare iron wires. It is evidently also easily injured by the teredo and other insects, and special armour is now applied to prevent this.

When used for underground wires it is exposed to more danger from the drying and oxidising effect of air, as well as to the attacks of insects and other damages, which were pointed out by several speakers in the recent discussion on this subject at the meeting of the Society of Telegraph Engineers. In hot climates it has been found necessary actually to place the underground wires, insulated with gutta percha, in pipes filled with water, as at Aden and elsewhere; neither gutta percha nor india rubber, in the form of Hooper's core, will stand when buried dry. Even in England, when wires have been laid for any distance under ground, special means have been taken to keep the gutta percha from contact with the air. Thus, at first, the wires were taped and then tarred and sanded. The tar used was coal tar, and this was found injurious to the percha. The underground lines between London and Liverpool, laid some twenty-five years ago, were soon abandoned, but some laid between Manchester and Liverpool, about eight years ago, and protected by yarn and Stockholm tar, have stood fairly well. But this process has its disadvantages. Although the insulation resistance by gutta percha has been greatly raised, there is reason to believe that this is not the only quality to be looked for in the material, for, Mr. Fleetwood, who has charge of the London street wires, in speaking at the Telegraph Engineers, said that the old gutta percha stood better than that of later years, and he especially condemned Chatterton's compound, and stated that no joints had failed since the abandonment of this compound in the joints of the Post Office wires. The striving after high insulation resistance and low induction capacity may possibly be leading the principal makers of gutta percha covered wire to mixtures and processess which, though attaining these ends, may be injurious to the durability of the material. Unfortunately, engineers and electricians to companies are kept from knowing any of these processes, and thus cannot watch the effect of any particular one. There is a belief, prevalent, however, that the high mastication to which gutta percha is subjected to obtain low inductive capacity lessens the durability of the material. Engineers can only judge by their tests of what they obtain, and as yet have looked a good deal for high insulation and low inductive capacity. Those that have authority over lines and records must now try to trace where durability lies, as this is naturally the greatest desideratum of all qualities. It is a pity, however, that the exigencies of trade should shut the superintending engineers and electricians out of the gutta percha works and the secrets appertaining thereto, as it is impossible that they can find the right path easily when working so much in the dark. If the manufacturers have special processes let them by all means patent them, and then make no further secret of them. In no other class of engineering has the engineer to use and inspect materials the manufacture and processes appertaining to which are kept secret from him, and in which processes materials may be mixed without his knowledge.

Turning to india rubber, Hooper's core has the advantages of standing the the direct rays of the sun, and considerable heat without injury, but it appears to fall in its insulation with time. The 500 miles of cable laid in the Persian Gulf ten years ago with this core seem, however, in spite of its fall of insulation, to be giving perfect satisfaction. It is maintained, however, that india rubber, even in the case of Hooper's core, absorbs water, and that this is the cause of its fall in insulation. Mr. Henley has lately introduced to notice a core which may be briefly described as Hooper's core, with its pores filled up with ozokerit. It has high insulating powers, and Mr. Henley maintains that it will not absorb water. Ozokerit has been used with advantage by the Post Office with tape to protect gutta percha, and Mr. Henley's idea seems a good one. Certainly if india rubber, as applied by Hooper's process, can be made to maintain its electrical qualities, its high insulation resistance and low inductive capacity, and, above all, its capability of standing heat should render such a core of the greatest value, particularly for tropical climates. But whether this can be done or not

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by Henley's process, there remains ample room for the introduction of any material that will stand air and heat better than gutta percha.

The introduction of any new material is, however, very uphill work, and, indeed, it seems that the moving powers are now slower than ever in experimenting. Mr. Henley's process is evidently sufficiently proved by the experience of Hooper's core and the nature of the improvement to warrant any board in experimenting on it on a moderate scale, yet scarcely more than a few miles have been ordered. The Indo-European Government Department has, we understand, sent a short piece to India, and some few miles have been ordered by other administrations. The material, however, is evidently of sufficient promise to warrant bolder experiment than this, for if gutta percha can only be preserved by all sorts of taping and tarring in this country, and by making submarine canals for it to lie in abroad, it is evident that it is not well adapted for underground work, and that any material which promises so fairly to dispense with supplementary processes, and to stand the sun's direct rays, should be experimented on by lengths of some hundred miles both in this country and abroad.

EDISONIA.

The following communication has been addressed to the *Scientific American* by Mr. Francis R. Upton, Mr. Edison's assistant :—

With this I send you the report of Profs. Brackett and Young on the efficiency of Mr. Edison's machine for generating electricity.

As undoubtedly comparisons will be drawn between the figures there given and those which have been given by Dr. Hopkinson for the Siemens machine, an analysis of his figures is not out of place. In *Engineering* for May 9, 1879, a full report of the tests of Dr. Hopkinson may be found.

He assumes, in calculating the work which is done in the circuit, that a gravity Daniell's cell has an electromotive force of 1·125 volts, though this form of cell is the weakest of any. In the calculations which the makers of other machines have rated the the efficiency of their machines, 1·079 volts has been assumed as the electromotive force of a Daniell's cell. As the work varies with the square of the E. M. F., his figures for work in the current must be multiplied by $\left(\frac{1\cdot079}{1\cdot125}\right)^2 = 0\cdot919$; that is, 91·9 per cent of the work given by his figures should be taken in comparing the Siemens with other machines. I take experiments 9, 10, 11, and 12 as representing very nearly the conditions of practical use. These show, according to his figures, 3·803 erg-tens in the current to 4·161 erg-tens given the machine by the belt, or 91·5 per cent. as the efficiency of the machine. Using the correction mentioned, 84 per cent. will be the true number. Taking the resistance of the machine as 0·683 ohm, which it would be after running a short time, these experiments show 52 per cent. in outside work; that is, of 5·55 horse-power given the machine by the belt, 2·89 horse-power were effective outside.

Profs. Brackett and Young show 90·7 per cent. converted, and 83·9 available outside.

I hope this statement will be sufficient to end the discussion into which I was drawn some time since regarding Mr. Edison's machine. He then claimed that $\frac{9}{10}$ of the power in the current could be made avaidable; now tests show $\frac{12}{13}$ of the energy in current are available.

It is not "childish," then, to make an armature with about one-eighth of an ohm resistance, as was claimed by others at the time.

REPORT OF COMPARISON BETWEEN THE PRONY AND EDISON DYNAMOMETERS, AND UPON THE EFFICIENCY OF THE EDISON DYNAMO-ELECTRIC MACHINE, BY PROFS. C. F. BRACKETT AND C. A. YOUNG, OF THE COLLEGE OF NEW JERSEY, PRINCETON, N. J.—EXPERIMENTS MADE APRIL 3, 1880.

FIRST COMPARISON BETWEEN THE DYNAMOMETERS.

The lever arm of the Prony was held down by the action of a spring balance applied at division 12, corresponding to a virtual circumference of 12 feet. The weight of the balance was 5·41 pounds, which is to be added to all its readings. The balance was read by Mr. Upton. After the experiment, the Edison dynamometer, transmitting no work, as read by Prof. Brackett, indicated (the mean of five readings, ranging from 990 to 995) 994·2 pounds. During the experiment the readings were made by Prof. Brackett and recorded by Prof. Young.

Duration of test, 10 minutes.

Number of revolutions of Prony shaft, determined by counter, 5,664.

Number of revolutions of main shaft, 1,880.

Mean indication of Edison dynamometer, deduced from Prof. Brackett's ten readings, varying from 920 pounds at beginning to 935 at end of experiment, 925·7 pounds.

From this, taking the mean reading of the zero, 994·2 pounds we have $\frac{994\cdot2 - 925\cdot7}{2} = 34\cdot25$ pounds.

Mean tension on Prony arm, 9·011 pounds, varying gradually from 10·91 pounds at beginning to 7·66 pounds at end of experiment, including weight of scale.

Work registered by Prony, 90·11 (lb.) × 12 (ft.) × 5,664 (rev.) = 612,460 ft. lb.

The diameter of main pulley is 38 inches.

The angle between belts of Edison dynamometer is taken at 44°. Assume $K = \left(\pi \times \sec. 22° \times \frac{38}{12}\right) = 10\cdot7297$. Then the Edison dynamometer registered K (ft.) × 1880 (rev.) × 34·25 (lb.) = 690,880 ft. lb. That is, the Prony recorded 88·6 per cent. of the work carried by the Edison dynamometer.

The comparison does not seem to us satisfactory on account of the considerable change in the conditions during the experiment.

SECOND COMPARISON.

Constants and observers as before.

Duration of test, 4 minutes.

Number revolutions of Prony, 2,281.

Number revolutions of main shaft, 752.

Mean tension on arm of Prony, 11·35 lb., varying from 11·60 to 10·97 in seven readings.

Initial reading of Edison dynamometer (mean of five), 994·2.

Final reading of Edison dynamometer (mean of five), 994·2.

Mean during comparison, 911·57.

(Mean of seven readings, varying from 910 to 915lb.).

Work according to Prony, 11·35 (lb.) × 12 (ft.) × 2,281 (rev.) = 310,680 ft. lb.

Work according to Edison instrument,

$$K\,(\text{ft.}) \times 752 \times \left(\frac{994\cdot2 - 911\cdot57}{2}\right) = 333{,}360 \text{ ft. lb.}$$

In this comparison the Prony registers 93·2 per cent of work indicated by the Edison dynamometer.

We regard this test as fairly reliable, the conditions having been very constant, and the outstanding difference of 6·8 per cent being reasonably accounted for by slip of belts and friction of journals between the two dynamometers.

TESTS OF THE EFFICIENCY OF THE DYNAMO-ELECTRIC MACHINE.

During both these tests the thermometer of the calorimeter and the Edison dynamometer were read as often as every minute, and great pains were taken to keep the water thoroughly stirred. The calorimeter was a galvanised iron vessel, 16·42 inches in diameter and 24½ deep.

The wire coil was wound upon a light wooden frame, so constructed as to serve as a very efficient stirrer.

The thermometer was an excellent instrument, by James Green, graduated to fifths of a Fahrenheit degree, each degree being about three-sixteenths of an inch in length.

Prof. Brackett read the dynamometer.

Prof. Young read the thermometer and made the records.

Mr. Upton and others, the speed of the main shaft and the indications of the high resistance galvanometer in the laboratory

CONSTANTS.

Weight of calorimeter (empty)	22·63 lb.
Heat capacity of same (taking specific heat at 0·112)	2·53 lb.
Weight of wooden frame	5·71 lb.
Heat capacity of frame (s. taken at 0·30)	1·71 water lb.
Weight of wire coil (54¼ turns, each turn weighing 5·84 grammes)	0·70 lb.
Heat capacity of wire (s., 0·10)	0·7 water lb.
Resistance of coil in calorimeter	1·720 ohms.
Resistance of leading wires taken as 1·300 of coil	0·0057 ohm.
Resistance of wire on revolving armature	0·140 ohm.
Resistance of coil on field magnets	1·470 ohms.

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FIRST TEST.

Total weight of calorimeter with contained water and everything in place	197·5 lb.
Hence from preceding data the heat capacity of whole	172·77 water lb.
Temperature of air	72·2°
Temperature of water at beginning	63·8
Temperature of water at end	80·5°
Gain during experiment	16·7°
Duration of experiment ..... 13m. 50s.	13·83⅓ m.
Dynamometer at beginning (free)	994·2
Dynamometer at end (free)	995·
Mean dynamometer zero	994·6
Speed of main shaft, beginning	174 per min.
Speed of main shaft, end	170
Mean	172
Mean reading of dynamometer during experiment	771·75lb.

(Varying from 760 to 781, 16 readings.)

E. M. F. of current maintaining field was 61 divs. of galvanometer, on which 168 d. corresponded to 16 Daniell cells, *i.e.*,

$$\text{E. M. F.} = \frac{61}{168} \times 16 \times 1{\cdot}079 \text{ volts.}$$

Energy expended on driving armature, as indicated by dynamometer = K (ft.) × 172 (rev.) × 13·833⅓ (min) × $\left(\frac{94{\cdot}6 - 771{\cdot}75}{2}\right)$ = 2,844,600 foot pounds.

Energy expended on field of force, $\frac{6}{5} \times \frac{45{\cdot}25 \text{ (ft. lb)}}{1{\cdot}47 \text{ (ohms)}} \times 13{\cdot}883 \text{ (m.)} \times \left(\frac{61}{168} \times 16 \times 1{\cdot}079\right)^2$ = 19,634 foot pounds.

Hence, total energy expended, 2,864,234 foot pounds,

Energy Realised.

a. In calorimeter = 772 × 172·77 × 16·7° =	2,227,420 ft. lb.
b. In leading wires $\frac{1}{300}$ of above	7,425 ft. lb.
c. In armature $\frac{14}{172}$ of calorimeter	181,302 ft. lb.
Hence,	
Total energy realised	2,416,147
Total available (*a* + *b*)	2,234,845
Hence,	
Total efficiency	84·5 per cent.
Total available	78·2 per cent.

Remarks.

During this test the driving power was about 6¼ horse power; the electromotive force of the field current, 6·27 volts, giving a current through the magnet wires of about 4¼ webers; and the current developed by the machine was about 45·8 webers through a total resistance of 1·866 ohms.

SECOND TEST.

Total weight, calorimeter and contents	200·00 lb.
Hence by preceding data, heat capacity =	175·27 water lb.
Temperature of air	71·1° to 71·8°
Initial temperature of water	63·2°
Terminal temperature of water	79·9°
Gain	16·7°
Duration of experiment	9 minutes.
Speed of main shaft, beginning	176 per m.
Speed of main shaft, middle	173 per m.
Speed of main shaft, end	177 per m.
Mean	175·33
Dynamometer reading before exp.,	985
Dynamometer reading after exp.	995
Mean dynamometer zero	990
Mean reading of dynamometer during the experiment (9 readings, between 645 and 656)	666
Electromotive force of field (by high resistance galvanometer) = $\frac{145}{168} \times 16 \times 1{\cdot}079$ =	14·901 volts.
E. M. F. of dynamo current = $\frac{240}{51}$ × 20 × 1·079 =	101·55 volts,
E. M. F. of terminals of dynamo; current broken, $\frac{290}{51} \times 20 \times 1{\cdot}079$ =	122·71 volts.

Energy Expended.

a. In driving armature according to dynamometer, K × 175⅓ (rev.) × 9·0 (m.) × $\frac{990-656}{2}$	2,827,550 ft. lb.
b. In maintenance of field of force, $\frac{6}{5} \times 44{\cdot}25$ (ft.lb.) × 9 (m.) × $\frac{(14{,}901)^2}{1{\cdot}47}$ =	72,180 ft. lb.
Hence—	
Total energy expended	2,899,730 ft. lb.

Energy Realised.

a. In calorimeter, 772 × 175·27 × 16·7° =	2,259,700 ft. lb.
b. In leading wires $\frac{1}{300}$ of above	7·532 ft. lb.
c. In armature $\frac{0{\cdot}14}{1{\cdot}72}$ of *a*	183·930 ft. lb.
Total energy realised (*a* + *b* + *c*)	2,451,162 ft. lb.
Available (outside of machine) (*a* + *b*)	2,267,232 ft. lb.
Hence—	
Total efficiency	84·5 per cent.
Available efficiency	78·2 per cent.

Remarks.

As a check we may compute the total efficiency from the galvanometer reading and the resistance: Energy developed, 44·25 (ft. lb.) × 9 (m.) × 101·55 (volts) × 1,866 ohms) = 2,200,500 ft. lb.

The discrepancy is fairly explained by the defective insulation of long wires leading to the galvanometer, as it was raining at the time.

During the experiment the driving power was about 9½ horse-power, and the current was 57·4 webers (according to galvanometer, 54·4).

Even with this current the spark at the commutator was very trifling.

SUMMARY.

	Total efficiency.	Available efficiency.
According to first test	84·5 p. c.	78·2 p. c.
According to second test	84·5 p. c.	78·2 p. c.

The Prony dynamometer is connected to the Edison dynamometer by a belt from the same countershaft, which is also belted to the electric generators. If we should assume the correctness of the Prony, and that the loss in the transmitting power between the Edison dynamometer and the arbor of the armature was only the same as between the two dynamometers, the above numbers would have to be increased in the ratio of 100 to 93·2 (see above), and we should have:—

Total efficiency	90·7
Available efficiency	83·9

C. F. BRACKETT,
C. A. YOUNG.

Princeton, N. J., April 10, 1880.

ELECTRIC TRANSMISSION OF SYNCHRONOUS MOTION.

Means of producing the synchronous working of two distant pieces of mechanism are important in the construction of telegraphs, especially the printing telegraphs based on the Hughes and Morse instruments so largely employed in France. It is probable, however, that in the future electric synchronism will receive far more extended application than it does at present, and, consequently, the recent investigation of this subject by M. Marcel Deprez has considerable value. The problem which M. Deprez set himself to solve was as follows:—Given a motor A and a receiver B, separated by any distance whatever, how to transmit through the medium of an electric current the movement of the motor A to the receiver B, as if a rigid axle connected the two in such a way as to make the angular velocity of B always equal in amount and sign to that of A?

M. Deprez was first confronted by this question on being asked by the Compagnie de l'Est to transmit to the interior of the guard's van of a train a movement rotation rigorously identical with that of the fly wheel of the locomotive. It is usual to effect this by means of mechanical devices, but M. Deprez succeeded in doing it effectually by means of an electrical arrangement incomparably more simple and cheap and convenient than the ordinary devices.

Upon the axle of the transmitter A are fixed two reversing commutators, each of which reverses the current, which traverses it twice every turn. But the positions of the axle corresponding

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to these reversals do not coincide, they follow each other at intervals of a quarter of a turn, so that, if we signify by the symbols $+a$ or $-a$, and by $+b$ or $-b$, the two currents issuing from the two commutators, the following table shows the relation which exists between the currents a and b and the angles described by the axle of A :—

Angles described by the axle of A.	Current sent by the first commutator.	Current sent by the second commutator.
0	$+a$	$+b$
$\frac{\pi}{2}$	$+a$	$-b$
π	$-a$	$-b$
$\frac{3\pi}{2}$	$-a$	$+b$

The two circuits leaving the transmitter will therefore be traversed by currents alternating in four different combinations at each turn, namely, $+a+b$, $+a-b$, $-a-b$, $-a+b$.

Let us pass now to the receiver. It consists essentially of a permanent magnet or electro-magnet having between its poles two straight electro-magnets or armature coils, susceptible of being rotated round an axle coinciding with the axis of the magnet. If we pass in each of the electro-magnets currents of equal intensity but of any sign soever, experiment shows that the right angle formed by these electro-magnets places itself in a position of equilibrium such that it is bisected by the straight line joining the poles of the permanent magnet, and, moreover, that to each of the combinations of current indicated above there corresponds a certain definite position of equilibrium of the electro-magnets. It follows that if the axle of A be turned the emissions of current which result from it will impress on the axle, the receiver B, a movement of rotation resulting from successive impulses which renew themselves four times per turn, and that the movement transmitted to B will be of *exactly the same speed and sign* as the movement of A.

Experiment proves that this apparatus is capable of transmitting the work of a motor from one point to another with *conservation of the angular velocity*, an important condition which has not been realised in any of the plans for transmitting power by means of electricity. The currents necessary for its action can, of course, be generated by either a battery or a dynamo-electric machine.

Further, since any movement whatever may be considered as composed of two movements of rotation, this apparatus, thanks to a simple mechanical adjunct, permits of sending either a design or writing to a distance.

THE THERMO-ELECTRIC FORCES BETWEEN METALS AND LIQUIDS.

Contact electricity has engaged the attention of physicists of late, not only in England, but in France, Germany, and Italy, by Becquerel, Bleekrode, and Paccinotti, and some interesting experiments have been made by M. Bouty, and brought before the French Academy of Sciences.

M. Bouty's experiments consisted in measuring the electromotive forces developed when two plates of the same metal were plunged in two portions of the same liquid at different temperatures. To do this he employed the usual neutralising or nil-reading method, which consisted in compensating the electromotive force to be measured by a variable difference of potential derived from a circuit of known resistance traversed by the current from a Daniell cell. The arrangement comprised, 1st. The thermo-electric apparatus formed of two tubes containing the liquid and plates; these tubes being connected by a long capillary siphon, and plunging one in a bath of cold water, and the other in a water bath of which the temperature could be varied at will; 2nd. A Lippmann electrometer sensitive to $\frac{1}{10000}$ of a Daniell cell, and brought back to zero in each experiment by conveniently regulating the derived electromotive force. Two sensitive thermometers give the temperature of the electrodes, and an easy calculation furnished the value of the thermo-electromotive force in a fraction of a Daniell. The use of an electrometer avoids the passage of a current in the derived circuit, and the consequent polarisation of the plates.

In general, the two plates are not completely identical, and a slight difference of potential in one direction or the other is observed between them when the baths are at the same temperature, but when a difference of temperature establishes itself the electromotive force varies, in general, very regularly, and returns to its first value when the temperature becomes again the same in both. To prevent grave irregularities it was necessary that the liquids should be prepared with distilled water deprived of air by recent ebullition; and also to abstain from raising the temperature above 50° or 60° in measuring, in order that the mercury of the electrometer should maintain itself at a fixed level. The agitation of the liquid, while being warmed or cooled is, in fact, accompanied by the production of transient but sometimes very considerable electromotive forces, which are in all cases observed by M. Bouty of contrary sign to the thermo-electric forces, which they partially mask.

In cases where the metal is placed in contact with a solution of a salt of the same metal, for example, copper in contact with a solution of sulphate of copper, the thermo-electric force is rigorously proportional to the difference of temperature of the two plates, and does not vary sensibly with the degree of dilutation of the salt. Its mean value for 1° centigrade is 0·000688 of a Daniell cell.

The salts of copper, zinc, cadmium, protoxide of iron, suboxide of mercury, chloride of gold, and chloride of platinum give also perfectly regular results. In all cases the warm metal is externally the positive pole. M. Bouty's observations are summed up in the following table:—

Metal.	Liquid.	EMF for 1° C. at difference of temperature. Daniell cell.	Mean for each metal.
Platinum.	Chloride of platinum	0·000735	0·000734
Copper	Sulphate of copper	0·000688	0·000696
	Nitrate of copper	0·000704	
Amalgamated zinc.	Chloride of zinc	0·000677	0·000705
	Sulplate of zinc	0·000696	
	Nitrate of zinc	0·000692	
	Acetate of zinc	0·000756	
Cadmium	Chloride of cadmium	0·000615	0·000616
	Sulphate of cadmium	0·000598	
	Nitrate of cadmium	0·000614	
Mercury..	Nitrate of sub-oxide of mercury..	0·000140	0·000140
Gold	Chloride of gold	0·000024	0·000024
Iron	Sulphate of iron (ammoniacal)...	−0·000024	0·000002
	Sulphate of protoxide of iron ...	0·000000	
	Protochloride of iron	+0·000077	
	Acetate of iron.....	+0·000087	
	Tartrate of protoxide of iron.....	−0·000127	

It may be remarked in connection with these results that zinc not amalgamated is more or less heterogeneous and gives irregular results.

It will also be observed that salts of the same oxide give very sensibly the same number, and that the numbers relative to copper and to amalgamated zinc are almost identical, hence the fact, long known, that the electromotive force of a Daniell element remains nearly constant in spite of temperature. In fact in the Daniell cell the potentials developed at the two poles act in contrary directions to modify by equal quantities the electromotive force of the element.

The regularity of the above results is not obtained when the cool metal is externally the positive pole. The metals possessing that property are often attacked by the liquid which touches them, and then, it may be said, the electromotive force is never constant; its variations range in certain cases from $\frac{5}{1000}$ or $\frac{6}{1000}$ of a Daniell cell to sometimes several hundredths, and measurement of it becomes uncertain. M. Bouty, nevertheless, gives the principal results of his experiments under these conditions as follows :—

Metal.	Liquid.	Mean E M F for 1° C. (between 10° and 30° C.) Daniell.	Mean Daniell.
Silver	Nitrate of silver	−0·000165	−0·000202
	Silver bath for galvanoplasty ...	−0·000240	
Iron	Per-chloride of iron	−0·00170	−0·00156
	Nitrate of iron	−0·00169	
	Sulphate of per-oxide of iron ...	−0·00149	
	Iron alum (alum de fer)	−0·00134	
Nickel	Chloride of nickel	−0·00208	−0·00214
	Nitrate of nickel	−0·00234	
	Sulphate of nickel	−0·00200	

Magnesium and aluminum gave values greater than the preceding, but very uncertain.

In most cases the variation of electromotive force ceased to be proportional to the temperature, the foregoing numbers being only means corresponding to differences of temperature of less than 20° C.

It may be remarked that salts of the same oxide furnish always sensibly the same numbers. The mean relation to the salts of the protoxide of iron is almost nothing, whilst for the salts of the sesquioxide it has a considerable negative value. Moreover, the electrometer betrays $\frac{1}{500}$ of sesquioxide of iron in a salt of protoxide. The sulphate of protoxide of commercial iron impurified behaves almost like a salt of peroxide.

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CORRESPONDENCE.

NOTE ON MR. RAMSDELL'S LETTER TO THE "SCIENTIFIC AMERICAN."—*The Electrician*, May 8.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. Ramsdell does not question the accuracy of the determination of the resistance and current, and therefore of the actual energy developed in one of Edison's burners, as determined by Messrs. Morton, Mayor, and Thomas; and we may, therefore, take it that he accepts the statement that the energy in twelve lamps, with an aggregate light of 120 candles, equals one horse-power. He, however, endeavours to prove that this light can be obtained by joining the twelve lamps in multiple arc, with the expenditure of $\frac{5}{12}$ of a pound of coal, each lamp, of course, emitting the same light as before, and developing the same energy.

Now, inasmuch as an ordinary steam engine consumes 3lb. of coal to generate one horse-power, we have in the proposed arrangement one in which force is actually created; for we get one horse-power in the engine actuating eighty-six lamps with a collective energy equal to $7\frac{1}{5}$ horse-power.

Mr. Ramsdell appears to consider that so long as the E.M.F. of the dynamo is unaltered the same horse-power will be necessary to generate a current of one, ten, or even 100 webers per second. A brief consideration of the formula $H = C^2 Rt$ will show where the fallacy lies.—Yours, &c., J. G.

Cardiff, May 13.

ELECTRO-METALLURGICAL PROCESSES OF SEPARATION ADOPTED BY M. ANDRE OF EHRENBREITSTEIN.

In treating certain *mattes* or impure compounds of nickel, or impure compounds of nickel, cobalt iron and copper, M. André connects them with the positive pole of a battery or other electro generator, and suspends them as anodes in tanks of dilute sulphuric acid. As the anodes dissolve, the copper alone, in a state of great purity, is deposited on the plates of copper or carbon which constitute the cathode. No nickel is deposited so long as the solution remains acid, and this metal, therefore, becomes accumulated in the fluid. To separate from the latter the last traces of copper, an anode of carbon is used, at the close of the operation, in lieu of the metallic compound. Finally, a slightly acid solution of sulphate of nickel is obtained in admixture with more or less sulphate of iron, and (?) sulphate of cobalt. To separate the iron, the solution is neutralised with ammonia, and evaporated in leaden pans, atmospheric air being at the same time passed through the fluid. The iron is thus precipitated as a flocculent hydrate, and is separated by decantation or filtration. According to the *Revue Industrielle*, pure sulphate of nickel may then be obtained by crystallisation.

To obtain the nickel in the metallic form, anodes of zinc or iron are employed, and, in order to prevent the contamination of the nickel solution with salts of these metals, a double diaphragm is employed between the anode and the cathode, and the solution contained in the partition formed by the two porous divisions is frequently, or continuously, withdrawn, and replaced by a solution (? ammoniacal) free from the metals in question. The cathode may be a plate of carbon, of nickel or of copper. Prior to deposition, the solution is preferably rendered ammoniacal, *i.e.*, the double sulphate of nickel and ammonia is formed. Anodes of carbon of platinum were soon found to be impracticable, by reason of the strong opposing electromotive force brought into action during the process of electrolysis.

The nickel ores of New Caledonia, treated with sulphuric or hydrochloric acid, yield a solution from which pure nickel may be deposited by the above process, after removal of the copper. But if the solution be rendered neutral by means of ammonia, in the first place, then the copper and nickel are thrown down together, and may be utilised as an alloy, after removal of the deposit from carbon cathodes by means of brushes.

M. André has applied a modification of the process for the separation of the metals contained in old coins and other alloys, sometimes in the form of filings. The alloys are made the anode in dilute sulphuric acid; and between the anode and cathode is placed a frame supporting two sheets of cotton fabric, the interval between these being filled with granulated or scrap copper. When the alloy contains gold, silver, and copper, the two last metals only are dissolved, and the silver is precipitated on the copper contained in the above-mentioned partition; so that pure copper only is deposited at the cathode. The precipitated silver may readily be separated from the copper, and would not ordinarily require purificatiou.

In connection with the above process, which presents some points of novelty, the following claim, contained in the patent specification of Charles Watt, dated September, 1851, may be of interest:—

"4th. Separating metals from each other and from impurities by electricity, and by means of vessels with porous partitions. Gold may be thus separated from silver or copper by melting it with any oxidizable metal (if it contains less than three-fourths of alloy) and using it as the positive pole of a single cell Daniell battery in a solution of nitrate of silver; the alloy is deposited on the negative pole of the battery, the gold becoming detached and remaining in the compartment containing the metal to be purified."

Other similar means are detailed, with other solutions, and for purifying other metals.

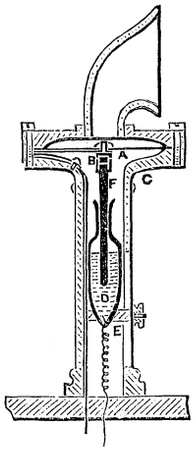
SIMPLE TELEPHONE TRANSMITTER.

BY GEO. M. HOPKINS.

There are telephones and telephones, but in the host of instruments so named the successful ones may be counted upon the fingers of one hand. Of telephonic receivers it may as well be said there are but two, for there are only two principles involved in their construction. Of transmitters there are but two that have gained any notoriety and retained their foothold as useful instruments.

Having a chronic liking for telephonic research, I have made it a point to try the various telephones as they have been made known to the public, and have found that with but few exceptions they are defective and useless as practical instruments, and interesting only at exceptional times, when the conditions for experiment are favourable and the adjustments delicately made.

In the course of these experiments the transmitter shown in the annexed engravings was devised, and it was subsequently developed into a usable instrument possessing all the qualities requisite in a telephone. In the first place, it is so simple as to be capable of construction by the merest tyro, and never needs adjustment. It requires neither call bell, keys, nor switches when used in an ordinarily quiet place, with a closed local circuit.



The transmitter is fixed to the bracket and stands vertically, with its sound-collecting mouthpiece pointed in the direction whence the sound proceeds. The receiver, which is an ordinary Bell instrument, stands when not in use over a curved pendent resonator, the smaller end of which projects through the shelf of the bracket and just enters the hole in the centre of the receiver mouthpiece.

Between the transmitter and the receiver there is a small induction coil, whose primary wire is connected with the local battery and the transmitter. One terminal of the secondary wire of the coil is connected with the receiving instrument and line, the other terminal is grounded.

The construction of the transmitter will be seen in the vertical section, Figure. The diaphragm, A, has attached to its centre a small brass cup, B, containing a button of ordinary battery carbon three sixteenths of an inch in diameter and about the same thickness. This carbon projects beyond the brass cup, and is surrounded by a short paper tube, which projects beyond the face of the carbon one eighth inch. A piece of copper foil placed between the brass cup, B, and the diaphragm extends to the edge of the diaphragm, where it is pressed by a spring in the cell, C,

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which is in metallic contact with a wire extending downward through the lower end of the instrument.

The standard supporting the diaphragm cell is hollow, about five-eighths inch internal diameter, and the height of the diaphragm above the bracket is four inches.

In the standard there is a bottle, D, of special form, supported by a ring, E, having a threaded stud extending through a slot in the standard, and provided with a milled thumb nut, by which it may be clamped at any desired height. The bottle D has a long narrow neck, about three-sixteenths inch internal diameter, and a platinum wire blown in the lower end connects with the local circuit wire, which is coiled to admit of moving the bottle up or down. This wire extends through the base of the instrument. The bottle D (as will be seen indicated in the Figure) is partly filled with mercury, in which floats a pencil, F, of carbon of the kind used for electric lighting by incandescence. This pencil is one-eighth inch in diameter, two and one-eighth inches long, and is made slightly convex and very smooth at the ends. The mercury buoys the carbon up so that it is always kept in light and uniform contact with the carbon button, while it also forms part of the conductor in the local circuit. The carbon attached to the diaphragm is perfectly plane on its contact surface, and as smooth as it can be made by means of a fine file.

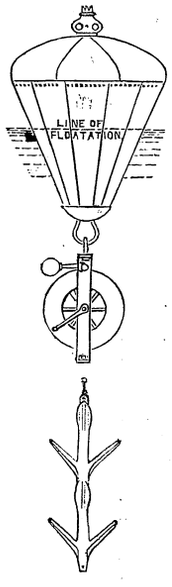
The diaphragm, which is of mica, has one and three-fourths inches free to vibrate. It is rather stiff, and is clamped firmly in its cell. The surfaces between which the diaphragm is clamped are perfectly true, and made of material not liable to warp. Wood well soaked in paraffin answers a good purpose, but vulcanite is far better.

The induction coil used with the instrument is of the ordinary form, two inches long, one inch in diameter, with a three-eighths inch core of No. 18 soft iron wires. The primary coil consists of three layers of No. 18 silk covered copper wire, and the secondary of No. 36 in sufficient quantity to fill the spool. One cell of Leclanché or Fuller battery will work the transmitter, but two will augment the volume of sound.

As to the efficiency of this instrument it will bear comparison with other transmitters, and in one or two points it seems to have an advantage. It will transmit speech clearly whether the speaker is within ten inches or as many feet of the instrument. Although a call bell may be used in connection with it, generally none will be required, as by saying o-o-o-o loudly in the mouthpiece, a trumpet-like sound is heard in the receiver at the other end of the line, which, although not very loud, is sufficient to attract attention in a measurably quiet room.—*Scientific American.*

A PATENT "MARK" BUOY.

The enterprising firm of Johnson and Phillips has added another excellent piece of apparatus to that at the command of those in charge of cable laying. The object of this "buoy" is that vessels engaged in cable laying, or in repairing submarine cables, may have the means of marking a "position" without



much loss of time, and at a comparatively small cost. The accompanying diagram shows the arrangement adopted. The buoy is suspended over the water by a line made fast at any convenient point at the quarter or stern of the vessel. When it is required to use the buoy the line is cut or paid out so that the buoy drops into the water clear of the ship's side. Underneath the buoy proper is a drum carrying pianoforte steel wire. A detent actuated by the copper float ball allows this drum to revolve or not, according to the position of the ball. When the copper ball strikes the water the detent is raised, allowing the drum to revolve. A sinker is attached to the wire, and goes down as the drum revolves. If thought necessary the sinker can be recovered by winding up the drum, for which purpose a handle is provided. The cost of the sinker and 1,000 fathoms of mooring wire, however, is not more than £1, so that, as a rule, the trouble of recovery would not be undertaken. The length of sheet wire on the drum should be considerably in excess of depth of water. The operation of attaching the sinker to the wire is simple, and several drums containing different lengths of wire are provided, so that the requirements for special localities are always ready to hand. So far as we can tell without actual experience, this "buoy" will prove very useful, and we infer the same idea has struck those connected with cable work, inasmuch as several buoys have been ordered for such service.

REUTER'S TELEGRAM COMPANY (LIMITED).

The sixteenth ordinary general meeting of the shareholders of the above Company was held on the 19th inst. at the offices, Old Jewry, under the presidency of Colonel James Holland, the chairman of the Company.

The SECRETARY (Mr. Frederick J. Griffiths) read the notice convening the meeting, and the report of the directors was taken as read. It stated that the net profits for the year ending the 31st December last, after payment of current charges and deducting bad debts and rebate on unexpired subscriptions, amounted to £7,101, including £113 brought forward from the last account. The usual interim dividend of 2½ per cent. was paid in October last, and the directors now declared a further dividend of eight shillings per share, equal to 5 per cent., free of income tax, making a total distribution of 7½ per cent. for the year. This would absorb £5,492, and after adding £1,500 to the reserve fund there would remain a balance of £108 to be carried forward. The lease of the Company's offices expiring at the end of the current year, the directors have purchased the freehold of 24, Old Jewry.

The CHAIRMAN, in moving the adoption of the report and balance sheet, said he hoped they would consider them satisfactory. The figures shown in the balance sheet substantially amounted to this, that they were able to declare a dividend of 7½ per cent. on the proceedings of the year, and to carry over altogether about £1,600. They had, in fact, very nearly made 10 per cent. on their business for the past year, which he thought might be deemed, especially when they considered the difficulties they had had to undergo from wars and the depression of trade, as fairly satisfactory, and gave a good promise of continued reasonable success. They saw no reasonable cause to doubt that that would be the case. With regard to the figures, their sundry creditors account stood at a few hundreds more than last year, but it was simply a matter of figures as they stood on the 1st January, every shilling having since been paid. The sundry debtors account was nearly £2,500 more. The great bulk of that consisted of their agents' balances as they stood on the 1st January, and every one of them had since been remitted. There was, besides, an addition to the Egyptian debt of some £1,500, but that was a matter that was likely very soon to be settled, as a commission was now sitting at Cairo for the settlement and payment of such debts as the Company's. The lease of the Old Jewry premises stood in their books at £996, but a portion had been written off, and there now remained £497 to be dealt with. That would be cleared off at the end of the year. Turning to the profit and loss account he said they would see that the current expenses were about £300 or £400 more than they were last year, and telegrams and agencies had cost them £360 more. The total additional cost was £710, but, on the other hand, the subscriptions and commissions had been £2,350 more. The increase in the expenditure was consequent on the increase of their business, but the increase in their profit had been very much greater than the increase in the expenses.

Baron DE REUTER formally seconded the motion, and it was carried unanimously.

The CHAIRMAN next moved the re-election of Mr. James Stopford, the retiring director. That gentleman had been a director from the first, as they had all been, and he did not believe they could find a better.

Admiral Sir JOHN C. D. HAY, Bart., seconded the motion, and it was carried nnanimously.

Mr. STOPFORD briefly acknowledged the vote, and expressed a hope that he would be able to render many more years' service to the Company.

On the motion of General J. F. M. BROWNE, C.B., seconded by Mr. KINDERSIDE, Messrs. Quilter, Ball, and Co. were re-elected auditors.

An extraordinary general meeting was then held for the purpose of authorising the directors to borrow from time to time any sum or sums of money not exceeding in the whole the sum of £10,000, and to secure the same by mortgage of any of the Company's property or otherwise, for completing the purchase of the Company's offices, and for other purposes of the Company, if required.

The CHAIRMAN stated that the lease of the premises they now held would terminate at the end of the present year. The proprietors or trustees of the building were not willing to renew the lease, and the building was going to be sold. They endeavoured to find other eligible premises, but they could not do so at a sufficiently moderate rental, and they were at last compelled to enter into negotiations for the purchase of the building. There were many advantages in having permanent premises, and they thought they had acted judiciously in purchasing the site and building for the sum

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of £13,000. They had a reserve fund of £8,000, but they could not devote the whole of that towards the purchase money. They therefore proposed to borrow £10,000, of which they anticipated that they would only require £7,000 at present, and they would use £6,000 of the sum standing at the credit of their reserve. Sooner or later it would be necessary to raise the whole of the £10,000. They considered the £13,000 invested in the building and site was of itself an admirable reserve. The site was freehold. He then moved a resolution in accordance with the notice convening the meeting.

Baron DE REUTER seconded the motion, which was carried unanimously, and a vote of thanks to the chairman and directors terminated the proceedings.

GERMAN UNION TELEGRAPH AND TRUST COMPANY (LIMITED).

The ninth ordinary general meeting of the shareholders of the above company was held on the 20th inst. at the City Terminus Hotel, under the presidency of Sir James Anderson.

The SECRETARY (Mr. William Payton) read the notice convening the meeting and the minutes of the last meeting, which were approved by the present meeting, and signed by the chairman. The report of the directors for the year ending the 1st inst. was taken as read. It stated that the total recipts during the year amounted to £12,227, which, with the balance carried forward from last account, made a total of £12,268. The working expenses for the same period amounted to £462, leaving a balance of £11,805. Out of this amount an interim dividend of 5s. 9d. per share was distributed on the 21st January last, and the directors now recommended the payment of a further dividend of 6s. per share, making a total distribution for the year of 11s. 9d. per share, free of income tax, or at the rate of £5 17s. 6d. per annum upon the capital of the company, and the directors had also written off £74 from the expenses of formation of the company, leaving a balance of £51 to be carried over to the next account. The company's cable and land lines remained in good order and condition, and business during the last year had been going on in a satisfactory manner. The Telegraph Conference, held last year in London, had led to the introduction of some important changes, such as the general introduction of the one word rate, and the reduction of tariffs, which so far had led to a diminution of revenue.

The CHAIRMAN said that since their last meeting the number of the shareholders had increased by several hundreds, and they anticipated a larger meeting, or otherwise they would not have engaged the room where they then were. After apologising for the absence through ill health of Count Oscar Reichenbach and Mr. Henry Weaver, he said that the main point to bring before the new shareholders was a short statement of the origin of the company, and how it happened to be an English company at the present time. The company was formed originally in Berlin in 1871—a purely German Company, and nothing that they could do could alter that fact. The Imperial Government of Germany would not allow any transfer of any concession given by them to any nation whatever. It so happened that all the shares of that company except those held by the directors were held in this country, and the leading shareholders were extremely anxious to have an English company formed as far as it could be formed. In 1872 the matter was taken in hand by the leading shareholders, and the present board were solicited to act as directors. They had much trouble at that time to get articles of association in the way they desired in the first place, and secondly to reduce the expenses, which to some extent they had accomplished. Their colleague, Count Reichenbach, went over to Berlin, and saved an outlay of some £900 a year, and it was only fair to say that the board in Berlin met them in every way possible, acquiescing in every suggestion they had to make, and carrying them out as far as lay in their power. They made the English board their agents, and gave up the fees they had received up to that time—£500 a year, which was more than was now expended for their management, directors' fees, office rent, salaries, and all other expenses. The company was as far as it ever could be an English company. They held the company's shares in the Bank, and the coupons were cut off by them at the proper time, and that constituted their dividend. With regard to the report of the directors, the main point was this, as it concerned them more than anything else—it was an important and gratifying fact that besides paying a fairly good dividend, they had the reserve fund of £12,800 and a renewal fund of £6,280, altogether £19,000, which was a very fair reserve and renewal fund. If they went on increasing in that way their property might soon be considered—indeed he now considered it—a very good one. They had nothing to do with working the company here. It was altogether worked by the Submarine Company in this country, and by the German Government in Germany, and any directorial work that was required between the concessionary Government and the company, and between the Submarine Company and the Anglo-American Company was carried on by the Berlin Board. They themselves were merely the agents in this country, and merely gave the shareholders their dividend and looked after their interests whenever it was required to do so, and they were met fully and cordially by the Berlin Board. The Submarine Company really worked the concern in London, and the Anglo-American Company engaged to give the German Union Company a certain rebate upon the traffic transmitted over their lines so long as the German Union dividend did not of itself amount to 10 per cent. He thought they could do no more towards reducing expenses or putting things in a fairer or more square form. He then moved the adoption of the report and accounts, and the payment forthwith of the dividend recommended.

Mr. H. G. ERICHSEN seconded the motion, and it was carried unanimously.

On the motion of the CHAIRMAN, seconded by Dr. DRAGE, the retiring director, Mr. Erichsen, was re-elected.

Dr. DRAGE next moved, and Mr. DARLING seconded, the re-election of the auditor, Mr. Henry Dever.

A vote of thanks to the chairman and directors terminated the proceedings.

NEW PATENTS, 1880.

1511. TELEPHONE SWITCHES....*(A communication).—J. H. Johnson.*
1552. ELECTRIC LAMPS.—*(A communication).—A. M. Clark.*
1553. ELECTRIC LAMPS.—*(A cammunication).—C. D. Abel.*
1556. ELECTRO-PLATING.—*H. A. V. Wirth.*
1580. DYNAMO ELECTRIC MACHINES.—*(A communication).—E. P. Alexander.*
1585. ELECTRO-MAGNETS.—*G. Scarlett.*
1649. ELECTRIC LIGHTING.—*(A communication).—W. R. Lake.*
1704. ELECTRIC LAMPS.—*(A communication).—W. J. Haddan.*
1705. ELECTRO-DEPOSITION OF ALUMINIUM.—*L. A. Davies.*
1720. TELEGRAPH WIRES.—*J. R. Edwards.*
1738. TELEPHONY.—*S. Russell (Brooklyn, U.S.A.)*
1751. ELECTRIC SIGNAL APPARATUS.—*(A communication).—W. Morgan Brown.*
1764. TELEPHONES.—*R. M. Theiler.*

ABSTRACT OF PATENTS.

2795. ELECTRIC AND OTHER TIMEPIECES, *H. Port and T. Varley.—Dated 9th July*, 1879. 6*d.*

The pendulum is first set in motion, and when it arrives almost at the end of its swing, a light arm attached to the pendulum strikes against the impulse meter, which it moves through a short distance, at the same time completing the electric circuit which magnetises the electro-magnet and draws the armature and a movable rest, which supports the impulse meter, against a second stop. In mechanical power clocks the movable rest is actuated by a cam, and catches hold of the rest instead of the spring and electro-magnetism.

3436. GALVANIC BATTERIES, *R. C. Anderson.—Dated 26th August*, 1879. 6*d.*

The ordinary positive and negative elements are employed, such as zinc and carbon, the former acted upon by any suitable acid, such as sulphuric or muriatic acid, or a salt of an acid, but for the latter or negative element, oxalic acid in combination with a solution of bichromate of potash, to which a suitable acid or a salt of an acid is added, is employed.

3455. GALVANISING OR COVERING WIRE, &c. *E. Fox. Dated 27th August*, 1879. 6*d.*

The wire is coated with zinc or other metal by electro-deposition; and this is effected by causing the wire to pass slowly and continuously through a depositing bath.

3472. COMPOUNDS FOR INSULATING TELEGRAPH WIRES, *A. Wilkinson.—Dated 28th August*, 1879. 4*d.*

The wire is coated with two coatings of a compound consisting of 1lb. beeswax, 3lb. whitelead, with a proportion of Stockholm tar, and a small quantity of tallow. When the two coatings are set the core is passed through a hollow spindle for a plaiting or braiding operation, after which an outer coating of a compound composed of pitch, ground cork, and bisulphide of carbon, mixed in suitable proportions, and brought into a liquid form without heat, is applied.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices May 19.		Business Done Week Ending May 19. Highest.	Lowest.
Anglo-American Ordinary	62½,	63	63	62
Do. "B"	92,	½	93	91½
Do. "A"	34½,	35	36¼	34¾
Brazilian	8 3-16,	5-16	8¼	8 3-16
Cuba	9½,	10	9½	9½
Do. Ten per Cent. Pref.	16,	17	—	—
Direct Spanish	1¾,	2¼	—	—
Do. Ten per Cent. Preference	10¾,	11¼	—	—
Direct United States	11⅜,	⅝	12	11½
Eastern	8⅞,	9	8 15-16	8 13-16
Do. Six per Cent. Debenture	102,	104	—	—
Do. Five per Cent. do.	102,	104	102½	101½
Do. Six p Ct. Preference	12¼,	⅜	12⅜	12⅜
Eastern Extension	9⅛,	⅜	9⅜	9 1-16
Do. Six per Cent. Deb.	102,	104	—	—
German Union	8¾,	9¼	9 1-16	8 15-16
Globe Telegraph & Trust	6 1-16,	3-16	6 5-16	6⅛
Do. Six p Ct. Preference	11⅞,	12	12⅛	11¾
Great Northern	9½,	¾	9¾	9½
Indo-European	23,	24	—	—
Mediterranean Extension	3,	½	—	—
Do. Eight per Cent. Preference	10¾,	11¼	—	—
Reuter's	10,	11	—	—
Submarine	230,	240	239	239
West India and Panama	1¾,	2	1 13-16	1 13-16
Do. Six per Cent. Preference	7½,	8	7¾	7¾
Western and Brazilian	7½,	¾	8	7⅝
West. Union 7 p. Ct. 1st Mt.	117,	122	—	—
Do. Six per Ct. Sterg.	103,	105	—	—

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SLIP

INDEX.—The Index for Vol. IV. will be ready for issue with our next number.

TELEGRAMS FOR GERMANY.—On and after the 1st of June next the charge for telegrams to Germany will be reduced from 4d. to 3d. for each word.

DEATH BY LIGHTNING.—A young couple at work in their garden at Thun have been killed by lightning, their two little children by their side being unhurt.

NAME FOR A MESSAGE SENT BY TELEPHONE.—A correspondent of our American contemporary, the *Journal of the Telegraph*, suggests the adoption of "Phonogram" to designate a message sent by telephone.

JAMAICA.—Favourable reports have been published as to the result of the local post office telegraph system. The people appeared to be using it very freely, and the estimates of receipts originally prepared were likely to be exceeded.

TELEGRAPHS IN CYPRUS.—From a recently published Blue Book on Cyprus we learn that the natives have utilised the telegraphic facilities offered to them, for business and private purposes, to a much greater extent than was originally anticipated.

CHINA.—In 1878 the Viceroy, Li Hung Chang, had telegraph wires working between his yaman and the arsenal, a distance of three miles. It was reported that a line was to be erected between Tientsin and Taku. Has that line been erected, and is it working?

POSTAL TELEGRAPHS.—The estimate for the year ending March 31, 1881, is £1,210,736 against £1,115,195 for the past year, that is an increase of £95,541. It is probable that this extra money shows the cost of the erection of the main line to be built to the north.

THE BRITISH ELECTRIC LIGHT COMPANY.—What may be termed the inauguration of the electric light in the City took place on Friday evening, at the Vaults of the Royal Exchange, which have been fitted up by the British Electric Light Company. We shall fully describe the work in our next.

CABLE TO BERMUDA.—The scheme of laying a cable from Halifax to Bermuda is being agitated by various members of the Canadian Parliament, as well as by certain prominent business men. It is believed that England ought to have a cable between those points for the accommodation of the naval department, and for the purpose of trade and private use.

ATLANTIC CABLES.—The *New York Herald* suggests that the Atlantic cables should touch at the Azores, in order that the spans of cable should be as short as possible. This is an old suggestion, and the *Herald* may be sure that it has been well considered, and that the arguments against such a proceeding are not sufficiently strong to tempt the companies to try it.

THE SOCIETY OF TELEGRAPH ENGINEERS.—A special meeting will be held at the Institution of Civil Engineers, 25, Great George-street, Westminster, S.W., on Thursday, June 3rd, when a paper on "The Dynamo Electric Current in its Application to Metallurgy, to Horticulture, and to the Transmission of Power," will be read by C. William Siemens, D.C.L., LL.D., F.R.S., past President.

THE GOVERNMENT AND THE TELEGRAPHS IN THE UNITED STATES.—A Bill has been introduced in the House to establish a Government telegraph for the United States between Boston and New York, and Washington and intermediate post offices. It directs the Postmaster-General, for the purpose of testing the practicability of such a system, to establish a line by purchase on construction between the above-mentioned cities.

THE TECHNICAL EDUCATOR.—The current number of this publication contains the continuation of the subject, "The Electric Telegraph," dealing with the special description of the following apparatus:—Bright's Bells, Polarised Magnet, Chemical Telegraphs, Bain's, Bakewell's Copying Telegraph, Caselli's Pan Telegraph. These articles are by Mr. J. M Wigner, B.Sc., and the publication is one of the well known firm of Cassell, Petter, and Galpin.

CONSOLIDATION.—The consolidated telephone exchanges of New York have been named the Metropolitan Telephone and Telegraph Company. New cables are being laid across the Hudson, and a gang of men is at work putting up wires from Jersey City to Newark. It is believed that by the middle of May everything will be in readiness to give subscribers in Newark, Orange, Elizabeth, and other suburban places telephonic communication with New York.

ON A NEW ACTION OF MAGNETS ON ELECTRIC CURRENTS.—Mr. Hall states that the values of M, the strength of the magnetic field, given in his article (*Elec.*, vol. iv., p. 196), of this subject should be multiplied by a constant factor, which is nearly 2. The precise value of this reduction factor cannot be given, but the change does not affect the main conclusions. Mr. Hall hopes soon to publish more exact numerical results in regard to the new action, as observed in several different metals.

PUCK.—We have before us a copy of this paper, of May 8. The two-page cartoon of that date represents "The Decadence of the Wizard of Menlo Park. From the Phonograph to Polyform." There is one disturbing feature in Mr. Edison's career which his friends and foes do not sufficiently appreciate—his plodding nature. He does not give in, but continues his attempts to surmount every failure, and however adversely we may criticise what he has done we cannot be sure but he may be successful to-morrow.

AN IMPORTANT TELEGRAPHIC INVENTION.—Charles C. Buell, of New Haven, and formerly of this city, has invented a self-adjusting relay magnet, which is in practical operation in the American Union Telegraph offices at New Haven. The Page patent, owned by the Western Union Company, covers the employment of a retractile spring, or its mechanical equivalent, in the adjustment of relay magnets; but this invention avoids the Page patent, with as good results and less costly instruments, and is pronounced by electricians to surpass Edison's electro-motograph, designed for the same object.—*Springfield Republican.*

THE ACHARD ELECTRIC BREAK.—A railway break, which is instantaneously applied and continuous in its action, and which the inventor proposes to render automatic, is described by M. Hospitalier in *La Nature*. It is worked by means of two of the secondary batteries of M. Planté, each of these being charged by three Daniell cells. The action of the apparatus is dependent upon the adhesion of an electro-magnet to the axle of the wheels, by means of which two chains, attached to levers carrying friction blocks, are wound upon a drum. In some experiments upon a train of thirteen carriages, travelling at the rate of 73 kilometres per hour, the train was brought to a standstill in 21 seconds, moving through a distance of 215 metres after the break was applied.

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THE BRUSH LIGHT.—The British Government has given an order to the Anglo-American Electric Light Company, of London, which recently bought the English patents from Charles F. Brush, of Cleveland, for 24 of the largest size Brush machines, and 432 lamps. The order, which was received by cable recently, requests the Telegraph Supply Company to begin their manufacture at once. The order amounts to nearly 100,000 dollars, and when filled will make the number of Brush lights in operation about 3,000. The lights are for the use of the British Navy, and the Brush light was selected after a thorough trial of all foreign lights, a fact which will be regarded as a great triumph for a growing American industry.

GOING AHEAD IN AMERICA.—We are informed on the best authority that Milwaukee, instead of using the few telephones mentioned recently, has no less than 550 subscribers to its system. Some of the small Western towns in America of 20,000 population have 100 and 150 telephones, and in any place where a man can afford it, no matter how small the population, a telephone can always be found. In fact, so necessary an adjunct has the Telephone become to advanced civilisation, that *every* man who can afford it does not consider his business complete unless he has a telephone with which he can communicate with his customers. Chicago, with a population of half a million, has 3,000 telephones; St. Louis, with a population the same, has 1,000, and every day we hear of telephones being put up in even the most out of the way backwood places. The charge of the Milwaukee Telephone Exchange Company is £12 per annum, whilst in Chicago and St. Louis the charge is £20 per annum.

GEORGE B. PRESCOTT.—This gentleman, better known in England, perhaps, as an author than as a practical man, has resigned the position of electrician to the Western Union Telegraph Company, which he has held for more than ten years, to take charge of the Gold and Stock Telegraph Company as vice-president and executive manager. Under Mr. Prescott's administration of the electrical and engineering department, the construction and operation of the lines have been systematised and greater economy introduced. Special attention has been given to economy in the construction and use of batteries, the cost of which has been reduced to about 25 per cent. per mile of line, as compared with that at the time he was appointed electrician, while their efficiency and reliability have been greatly increased. The work of the electrical and engineering department has been transferred to a bureau in the department of Vice-President Van Horne. Mr. Prescott has also been elected President of the American Speaking Telephone Company.

THE TELEGRAPH AND EARTHQUAKES.—A recent letter from Mr. W. A. Goodyear, now director of a governmental mining and geological survey of San Salvador, states that more than 600 shocks of earthquake were felt there during the last ten days of 1879. They were heaviest about Lake Ilopango, where a shock occurred on the 23rd of December which broke the telegraph wires asunder and "made the ground on which we stood a perfect network of cracks, opened new springs of water, increased the rivulets in the vicinity to ten times their usual volume, muddied the waters of the lake in many places, and rolled down hundreds of thousands of thousands of tons of rocks and rubbish down the steep hills in the form of land slides." As a sequel to these earthquakes came the irruption of a volcano in the middle of Lake Ilopango on the night of January 20 to January 21. The volcanic island resulting now measures over five acres in extent, and shoots up a column of steam into the air of over 1,000 feet in height. This is the first instance we have heard of earthquakes interrupting land telegraph lines, though there are cases on record of their interrupting cables.

ELECTRICAL INSECTS.—"You are well acquainted with the history and properties of the *Raia Torpedo* and *Gymnotus electricus;* but, I dare aver, have no idea that any *insect* possesses their extraordinary powers. Yet, I can assure you, upon good authority, that *Reduvius serratus*, commonly known in the West Indies by the name of the *wheel bug*, can, like them, communicate an electric shock to the person whose flesh it touches. The late Major-General Davis, of the Royal Artillery, well known as a most accurate observer of nature, and an indefatigable collector of her treasures, as well as a most admirable painter of them, once informed me that, when abroad, having taken up this animal and placed it upon his hand, it gave him a considerable shock, as if from an electric jar, with its legs, which he felt as high as his shoulder; and, dropping the creature, he observed six marks upon his hand where the six feet had stood. Two similar instances of effects on the human system resembling electric shocks, produced by insects, have been communicated to the Entomological Society by Mr. Yarrell; one, mentioned in a letter from Lady de Grey, of Groby, in which the shock was caused by a beetle, one of the common *Elateridæ*, and extended from the hand to the elbow on suddenly touching the insect; the other caused by a large hairy lepidopterous caterpillar, picked up in South America by Capt. Blakeney R.N., who felt on touching it a sensation extending up his arm, similar to an electric shock, of such force that he lost the use of his arm for a time, and his life was even considered in danger by his medical attendant."—*Kirby and Spence's Entomology.*

THE TELEPHONE IN CHURCH.—At the suggestion of Mr. Beach a series of experiments have been made on the telephonic transmission of the church service. Two Blake transmitters were placed on a shelf before the speaker at the church of the Rev. H. W. Beecher, in Brooklyn, N.Y., and connected by the Bell Telephone Company and the Gold and Stock Company's lines to various parts of the city. The first experiment made on April 18 does not seem to have been very successful—the listeners nearest the church hearing pretty well, but those further away heard only the music and portions of the sermon. It was afterwards found that the line had been surreptitiously tapped, and extra telephones inserted. On the following Sunday, April 25, another trial was made, precautions having been taken against tapping, and special care also taken to give the most delicate adjustment to the transmitting instruments at the church. The result was successful. "From the opening note of the organ prelude to the last word of the preacher's voice, at the close of the service, everything was delivered to the ears of the listening telephoners in the most perfect manner, the tones that came over the wires being so full, round, clear, and distinct, it almost seemed to the hearers in New York, Yonkers, and Elizabeth as if they were stationed within the church itself directly in front of the speaker. The delivery of the music was equally perfect, every note of the organ and of the individuals of the choir being fully brought out. The majority of the participators in this experiment were persons accustomed to the use of the telephone, and their unanimous verdict was that the results obtained far surpassed anything of the kind within their previous experience."

THE RONALDS CATALOGUE.—This catalogue, so long promised, has just been issued by the Society of Telegraph

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Engineers. It is, however, not the fault of the society that the work has not been completed long ago, but arises, we believe, from the intense apathy of members, and hence the lack of funds. Almost by an accident the funds were forthcoming, and the production of a work, unique of its kind, was thus accelerated. The preface tells us how the library became the property of the Society of Telegraph Engineers, and this is followed by an admirably clear and succinct biographical memoir of Sir Francis Ronalds, F.R.S., by the compiler of the catalogue, Mr. A. J. Frost. It is hardly too much to say that this catalogue will be an absolute necessity in the library of every student of electricity. "It contains over 13,000 entries, comprising not only the books, pamphlets, and other publications in the Ronalds Library, but also the titles of all other works on the subject of electricity, magnetism, &c., which came to the notice of the compiler"—*vide* preface. The catalogue is arranged under authors' names, and great care has been taken to have the entries in the various languages correct. We have opened the work at hazard in various places, but have been unable to find more than one printer's error. Generally a first edition of a catalogue of such dimensions contains a good many mistakes, and that this work should be so free speaks well of the energy and painstaking care which have been shown by Mr. Frost in its compilation. We trust that the Society of Telegraph Engineers, having made so admirable a start, will not remain satisfied with the work, but will from year to year publish addenda carrying the work up to date.

The Columbia.—A new steamship has been just completed at the works of John Roach, at Chester, Pa., for the Oregon Railway and Navigation Company. The greatest innovation in the vessel is the adoption of the Edison electric light throughout the ship, the Columbia being the pioneer in this great improvement. These lights are maintained by four of Edison's dynamo machines in the engine room, arranged so that each line is under command of the engineer. The lights of the state rooms are under control of the steward on the outside. All of the rooms are fitted up with electric calls, and the offices, smoking room, &c., are provided with telephones —the smoking room being in connection with the steward's room, and the captain's with the chief engineer's, purser's, and steward's. Among other improvements are an electric telltale on the bridge, enabling the captain to tell, by simply pressing a button, whether the engine is going ahead or back, and at what speed, so as to prevent any accidents by mistaken signals from the bridge to the engine room. The Maxim electric head light is of novel construction, having its arc in the focus of a parabolic reflector, which may be turned in any direction and a cone of light projected a long distance, and is supplied by a current from one of Maxim's dynamo machines placed between decks. The four Edison machines are arranged along one side of the engine room. One of them is a dynamo electric machine used in exciting the field magnets of the others. The several circuits extending from these machines are controlled by a switch board at the farther side of the engine room. The state rooms on the upper and lower decks are on separate circuits; so also are the saloons. This arrangement admits the employment of the light as a signal to indicate when the time approaches for extinguishing the lights altogether, by simply breaking the circuit for an instant ten minutes before the prescribed retiring hour. The lamp fixture is of the same form as those used for oil lamps, and by an ingenious mechanical contrivance they are adapted to either the electric or oil lamp, so that should the electric lamp in any way fail the oil lamps may be immediately substituted. The electric lamp globes are frosted lightly by dipping them in hydrofluoric acid. The globe thus treated seems to increase the amount of light proceeding from the incandescent horse shoe carbons, so that by some they are credited with double the actual amount of light, while in reality one-twenty-third is absorbed by the globe.

Electricity as a Motive Power.—Mr. J. S. Cocksedge, writing from Bar le Duc to a contemporary, says:—About this time last year I sent you a short account of some experiments (*v. Electrician*, vol. iii., pp. 41, 51) by Mr. C. Felix, of Sermaize (Marne). This gentleman has continued his experiments, and at the Regional Agricultural Show, now being held in this town, his apparatus has been shown at work. It consists of the ordinary "Gramme" machine, worked by a semi-portable engine, furnished by Boulet and Co., Faubourg Poissonière, Paris; two coils of wire convey the power to a smaller "Gramme" fixed on a framework of wood, movable on four wheels. This acts as an intermediate motion, and has two broad-face pullies, one on each side, 20-inch and 14-inch diameter; these run at a speed, if required, of 800 a minute, the latter driving a six horse-power thrashing machine at a considerable distance from the main power. The 20-inch pulley might be used for driving any other machine if required. The ploughing apparatus, which is at work at the same time in the field adjoining, consists of a similar Gramme machine, fixed in a very solid framework of wrought iron, about nine feet long by five feet wide, standing on wheels, three feet six inches diameter in front, and four feet six inches behind. Shafts and a locking gear are also attached. There are two of these at work for ploughing, as in Fowler's double tackle. The Gramme has two pullies, as I before stated, one on each side. These, by friction rollers, work the drum of ploughing tackle, round which the steel wire rope is coiled, the drum being in the centre of the carriage, the wire escaping from the lower part near the ground, and guided in its course by two flat rollers. The plough is one of Howard's double-furrow, supplied by Mr. Pilter, Paris, and fitted for the purpose. The power is conveyed in an instant from the main power in the show yard by a coil of wire on wooden reels, long enough to reach several fields off. The plough worked cleanly and regularly about seven or eight inches deep. The ground was very hard and uneven, as this part of France is suffering very much from want of rain. One man is required to each machine, and one man to the plough, three in all. The ploughing was not very straight, as the people crowded about the plough and on the ropes. The driver could not see where he was going, and directly the plough reached the end of its course it was lowered and returned, the machine being thrown out of gear, and reversed with greatest ease. The machines are also advanced or retired without the least difficulty. When this is done, the friction rollers are detached, and the power conveyed to a chain and notched wheel, which moves the machine rapidly forward as the ploughing work progresses. The manager, Mr. Ducret, states it would be just as easy to work a three or four furrow plough as this double, but the holdings being small in this country, it is not necessary. Mr. Felix, who is here superintending his invention, has a large sugar manufactory at Sermaize, and there may be seen his various machines, worked by electricity, as we, indeed, see in this show yard. The officials connected with the show, and many others, were present, and the greatest interest was manifested in the trials. Electricity, as a motive power, is only in its infancy, but who can help feeling sanguine for its future?

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REPORT.

It is reported that some scepticism was shown as to the reality of our note relating to the Brush light, standing at the head of "Slip" in our last number, by some of the members of the Physical Society during the jaunt to Cambridge. We would beg to call attention to a more circumstantial note appearing this week under the head "Slip," and must confess that, if we are wrong, the evidence as to the order is strong enough to convince ordinary minds, and with such evidence before us we shall not object to make statements as to matters of fact.

Rumour has it that the Government has recently asked for tenders for two short lengths of cable, one of six wires, the other of one. The Western Union Telegraph Company of America has, we believe, given out a large order for wire to an English firm at Warrington.

With regard to other cable work we have nothing to report. At the time of writing no news as to the repair of the new Atlantic cable has been received, but may come, if the fault proves to be in shallow water, at any moment.

The quotations for gutta percha are, for genuine 2s. to 3s. 6d. per lb., for re-boiled from 3d. to 1s. 9d., while the prices for india rubber are as follow:—Para, fine 3s. 8d. to 3s. 9d., Negrohead 2s. 11½d., Central American 2s. 8d. to 2s. 11d., Assam and Pegu 1s. 7d. to 3s. Other East India 2s. to 2s. 7d., Madagascar and Mozambique 2s. 6½d. to 3s.

"Spare the rod and spoil the child" is a well-known maxim, but nowadays paterfamilias prefers to spoil his child, and is always on the alert to fill the columns of the daily papers with heart-rending accounts of how the schoolmaster has boxed Johnny or thrashed Sammy. What will be said of the latest innovation made public in the report of the Education Society's meeting last week, where it was advocated to introduce "electrical modes" of punishment. We might explain that in 1879 Professor Bain published a work on "Education as a Science." It was suggested in committee that the Education Society would be doing good work in criticising this book. The suggestion was adopted, and the matter of the work has been discussed at sessional meetings. The criticism was not of the kind ordinarily given, but frequently of a most uncompromising nature. Before resigning the presidental chair Professor Bain replied to some of these criticisms, and among others those brought forward against his theories of punishment, when, according to *The Times* report, he defended his suggestion as to the possibility of inflicting punishment by electricity. It was not the pain, but the manner of giving it that was the objectionable feature in corporal punishment. Professor Bain did not recommend the abolition of corporal punishment, but he asked for the subject to be considered in order to ascertain whether pain could be inflicted on the nerves without infringing the inviolability of the body and undermining the feelings of self-respect.

We shall have some thunder! is an exclamation often heard and almost as often agreed to, yet it is doubtful if speaker or hearer have ever investigated the why or the wherefore they should come to such a conclusion. Has any one ever investigated the atmospheric and physiological influences at work before, during, and after a thunderstorm? Is it a lack of ozone that causes the oppressive sensation before thunder, and is it excess of ozone that gives the feeling of freshness after? Perhaps some of our younger scientific friends can help us out of our ignorance.

Report says that M. Roosevelt, President of the Société du Téléphone Gower, is spending a few days in town. We sincerely trust that his sojourn in London may convince him that the existing telephone companies are not so powerful but that a good rival will have a chance of doing business.

An unknown correspondent sends us information relating to the American Society of Electricians and Telegraph Engineers. The title is peculiarly suggestive to our own Society of Telegraph Engineers. We cannot guarantee the accuracy of the information, but have no reason to think it other than authentic. This society is being rapidly organised, and will issue a monthly journal containing practical papers read before the society. It is contemplated to place at the disposal of the members a good library of standard electrical books and a laboratory. A singular feature in the society is to be the education of students. Ere long we may be able to give more details relating to this effort of our friends across the Atlantic.

CORRESPONDENCE.

THE APPLICATION OF SHORTHAND IN TELEGRAPHY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: It has for some time been a subject of discussion among telegraphists, whether the Sounder is superior to the "Morse machine" for telegraphic purposes; it being contended that the increase of speed gained by the use of the Sounder counterbalances the advantage of having a record of the message kept by the use of the Morse machine.

It is not my object to discuss the various merits of the two instruments, but merely to point out what seems hitherto to have been unnoticed, that by the use of shorthand the working speed of both instruments might be greatly increased.

Of course, shorthand could not be applied when receiving short messages, but when speeches or other lengthy matter is telegraphed, there is no doubt that the employment of shorthand would greatly increase the operator's speed in receiving the message.

The present speed at which messages are received is from 20 to 30 words per minute. Now, it is evident that the operator's speed in receiving the message must be in great measure controlled by his speed in writing it down.

In using shorthand, the operator would have a writing speed at his command far greater than his reading would require.

The application of shorthand to telegraphy is, however, prohibited at present, owing to the small number of telegraphic clerks and printers that have a knowledge of this useful art.

But, still, any means that will increase the speed of the telegraph's transmission is worthy of the attention of those interested in telegraphy.—Yours, &c., MARMADUKE CLARK.

ON A NEW RHEOTOME.*

I beg leave to submit to the Royal Society the following description of an instrument intended for the purpose of investigating the successive phases of the electrical change which takes place in the excitable parts of plants and animals in consequence of excitation. Two instruments intended for a similar purpose are already in use. One of them, known as the differential or repeating rheotome, was devised by Professor Bernstein, and described by him in his work "On the Excitation Process in the Nervous and Muscular Systems," published in 1871.† The other is called by its contriver, Professor Hermann, the Fall Rheotome, and is described in a paper published in "Pflüger's Archiv" in 1877. I have given a short account of it, which will be found in the "Journal of Physiology" (vol. i, p. 196).

In each of these instruments, as also in the instrument now to be described, two independent circuits, one of which may be called the exciting circuit, the other the galvanoscopic, are successively closed and immediately afterwards opened by a mechanism of such a nature that the *time-interval* between the two closures and (as regards the galvanoscopic circuit) the *duration* of the period of closure may be varied according to the purpose of the observation, and accurately measured. In the fall rheotome each of the times required is determined by the measurement of the distance which a falling weight passes through in the interval between the first and second event, as, *e.g.*, between the closure of the exciting and galvanoscopic circuits and between the closure and opening of the latter. In Bernstein's rheotome time is measured in terms of the rotation-time of a wheel, which is driven by an electro-magnetic motor.

Without making any comparison between the instrument now to be described and its predecessors, or venturing to claim for it any superiority, I think I am justified in bringing it under the notice of the Royal Society, on the ground that in very numerous experiments it has been found well adapted for its purpose, and that the value of the results obtained by means of it could not be

* Abstract of a paper presented to the Royal Society by J. Burdon-Sanderson, M.D., LL.D., F.R.S., Jodrell Professor of Physiology, University College.

† "Untersuchungen über den Erregungsvorgang im Nerven-und Muskel systeme," von J. Bernstein. Heidelberg, 1871.

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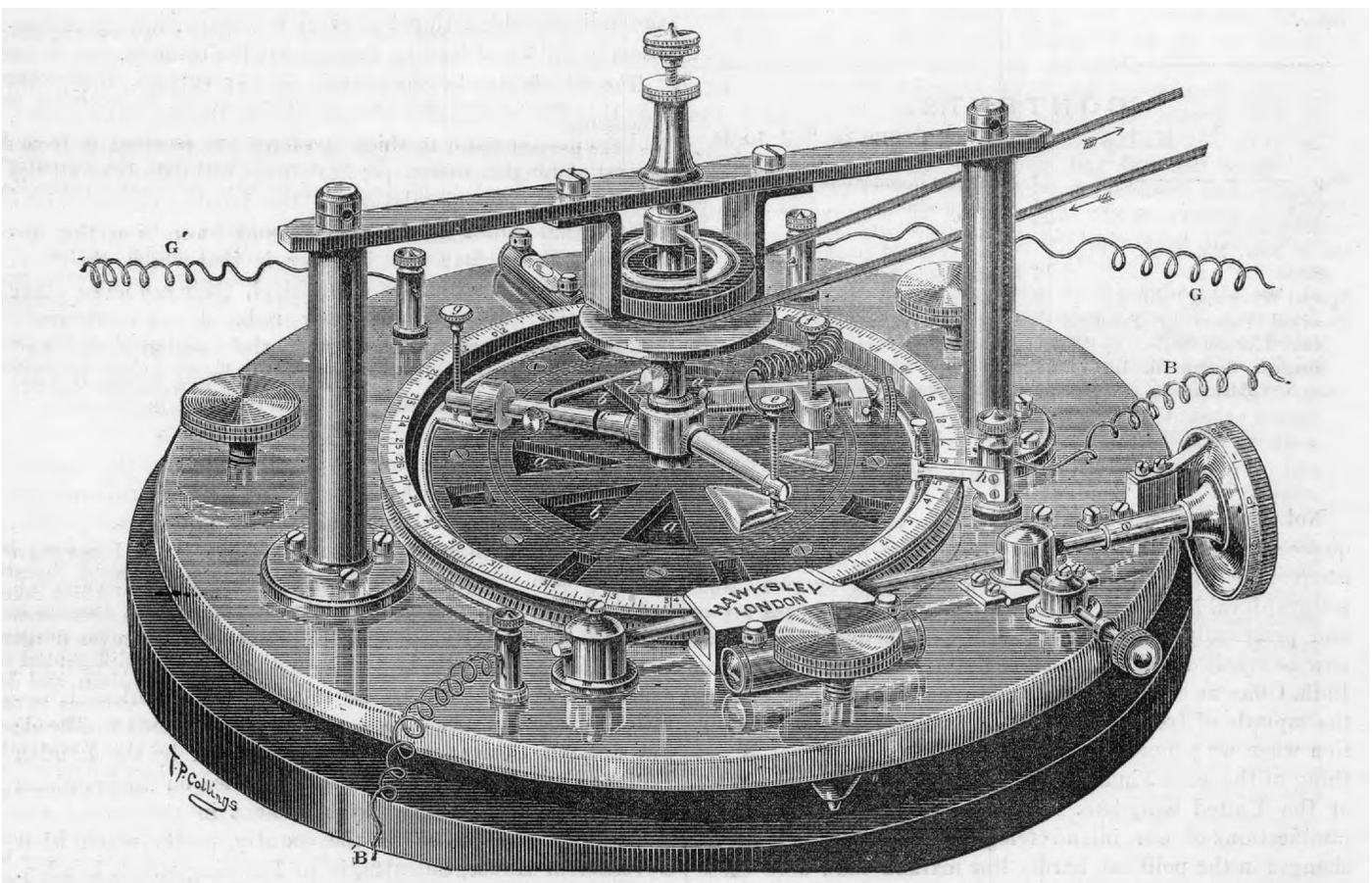
so well estimated by the reader without a knowledge of the construction and mode of action of the instrument used.

Description of the Instrument.

From a circular iron plate, supported on levelling screws, spring two strong brass pillars, each 6 centims. in height, on the summits of which rests a horizontal bar. In the middle of the bar is a screw, which ends below in a steel point. A similar steel point rises from the centre of the iron plate. On these centres works a vertical axis about 5 centims. in length. The steel point on which the lower end of the axis works is surrounded by a circular plate of vulcanite about ·5 centim. thick. In this plate are cut eight pools, of which the forms will be seen in the diagram. They are intended to contain mercury and are traversed by platinum wires, of which the arrangement is such that the pools *a*, *a*, *a*, *a*, and *b*, *b*, *b*, *b*, are severally connected with each other. The two rings of wire are insulated and are connected the one with the binding-screw, G, the other to the binding-screw, G′.

The fixed circular plate above described is surrounded by a movable annular plate of the same material and thickness, which also has eight excavations or pools, all of which can be brought into communication by means of an annular trough of mercury



by which they are surrounded. To the outer edge of the annular plate is fixed a graduated circle of brass, which revolves with it. Against this circle works a tangent screw, each turn of which corresponds to a single division of the graduation; this screw is furnished with a divided milled head and can be thrown out of gear when necessary by the auxiliary screw, in a manner which will be readily understood from the drawing. The vertical axis carries at its upper end a pulley, by means of which it is connected with a motor, and can be made to revolve at any desired rate. Above the pulley is a platinum wire, the end of which is bent downwards so as to dip into an annular pool of mercury, which is in metallic connection with the horizontal bar, and thereby with the iron plate and the binding screw B′. The vertical axis also carries three arms, of which one is longer than the other two; the longer arm carries at its end the vertical screw *g*; this screw is prolonged at its lower end by an amalgamated gold wire, the end of which dips into the mercury contained in the external pool, as the axis rotates. This arm is insulated at *e*, but is connected with the axis, and thereby through the annular pool above described with the binding screw B′. As the external pools are connected through the arm *h* with the binding screw B, B and B′ are in communication whenever the screw *g* is in contact with the mercury in any of the pools. Each pool is furnished with a vulcanite stop, by which it is thrown out of communication with the external pool. In the drawing all are thus out of communication excepting one.

The two shorter arms are in metallic connection with each other, but are insulated from the axis by a collar of vulcanite *d*. One of them carries a screw *e*, which like *g* ends in a gold wire, of which the tip is amalgamated; the other carries a similar screw *f*, and is so constructed that the screw *f* can be moved radially (*i.e.*, in a vertical plane which contains the axis of rotation) to any required distance from the axis. The two arms meet each other at an angle of 45°.

From the form and arrangement of the internal pools it will be evident that whenever the screw *e* is in contact with any of the pools *b*, *b*, *b*, *b*, the screw *f* must be in contact with the pools *a*, *a*, *a*, *a* (see Fig. 8) and further inasmuch as *f* is nearer the axis than *e*, the times at which *e* makes and breaks contact with the pool *b* must respectively precede and follow those at which contact with the pool *a* is made and broken by *f*. Consequently the time during which both are in contact (*i.e.*, during which the circuit G G′ is closed) is determined solely by the duration of the immersion of *f*, and can be varied by altering its distance from the centre.

When it is desired to use the rheotome for investigating the effects of series of excitations recurring at short intervals (tetanus of muscle or nerve), all the pools are equally filled with mercury.

Their equality must be tested by interpolating each set of pools in the circuit of a Grove's cell, which also includes a recording chonograph; if the chronographic record shows that the durations of the contacts are not perfectly equal, the error must be corrected by adding or subtracting mercury. For investigating the effects of single excitations only one of the external and one couple of the internal pools are used.

The drawing shows the arrangement of the apparatus as used in the investigations made by Mr. Page and myself of the electrical phenomena of the ventricle of the heart of the frog. The instrument is set so that the external contact *g* is broken at a moment which immediately precedes the immersion of *f*; consequently, the galvanometer circuit G G′ is open at the moment of excitation, but closed immediately after, remaining closed so long as *f* is immersed. By means of the tangent screw the interval between the opening of the exciting circuit B B′ and the closing of the galvanometer circuit G G′ can be varied at will.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

We cannot undertake to return drawings or manuscripts, and must, therefore, request Correspondents to keep copies.

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SPECIAL WIRES AND POLITICS.

Not long ago we drew attention to the political consequences which have followed the establishment of telegraphic intercourse with our scattered dependencies abroad. The telegraph cable has, in fact, created for us a homogeneous and practically compact empire, whose farthest limits can now be reached and administered from the Colonial or the India Office as certainly, and almost as expeditiously, as are the capitals of Ireland and Scotland. We had a dim perception when we penned the article just referred to that something of the same kind had been happening within the shores of the United Kingdom. Indeed it was obvious that the ramifications of our inland telegraph system had wrought changes in the political, hardly less marked than were those in the social, condition of the provinces; and this seemed especially true in respect to their relations with the political atmosphere of the metropolis. But we little suspected—only the initiated few could have suspected—that a silent revolution had occurred, so sudden, so unlooked-for, and of such gravity, as that which is described in the May number of *Macmillan's Magazine*. The remarkable narrative which has brought this fact to light gives an account of the rise and progress—one might now add the omnipotence—of the "London Correspondent;" and the arm which has raised this personage to power is, it seems, none other than the *Special Wire*.

About fourteen years ago it entered into the head of some ingenious person that the spare hours of evening and night-time, when wires are mostly slumbering, might be utilised for the wakeful purposes of provincial journalism. The project was an entirely innocent one, and had no ulterior aims beyond those which are usually the legitimate reward of enterprise. It originated in rebellion against the Intelligence Department of the old telegraph companies, whose collection of news was doled out rather grudgingly, and, some people suspected, not with strict impartiality. The growth of the provincial press had been not less rapid than that of its contemporaries in London, and its discontent now began to take a very energetic shape. This, indeed, was one of the reasons for its unanimous advocacy of the transfer of the telegraphs to the State. Meanwhile, however, two or three of the more forward spirits had found relief in special arrangements with the companies—in appropriating wires over which the renters could send what news they pleased, and as much of it as they could crowd into the hours between six p.m. and the time for going to press. *The Scotsman* and *Edinburgh Courant* were, we believe, the first to secure their independence in this way. Other papers, as a matter of course, followed their example; and in due course the proprietorship, more or less exclusive, of a *Special Wire* became the indispensable adjunct of every newspaper having pretensions to light and leading throughout the country.

The seemingly obvious consequence of this new departure was that the inhabitants of Edinburgh, Dublin, Manchester, and similar large towns would no longer have to wait for the arrival of London newspapers to obtain full details of all the latest news. The circulation of the London papers might suffer—that would be all. Such would have been the prediction. The actual fact, however, is that whilst their circulation has not materially diminished, their influence other than locally has been immensely reduced. The despised London Correspondent has beaten the London Press; and the process by which this has been brought about is what Mr. Wemyss Reid has undertaken to describe in *Macmillan's Magazine*.

Previous to the invention of the *Special Wire* the London Correspondent seems to have been a very poor creature indeed, retailing the gossip of clubs whose threshold he never passed, and the conversation of dignitaries whom he had never so much as seen. For all practical purposes he might as well have written, probably sometimes did write, from the back office of the country newspaper. But we have altered all that. The special wire had to be fed, and expensive facilities could not be paid for by the retailing of worthless tittle-tattle. Editorial offices soon appeared at the fountain head; the London Correspondent was superseded by the London Editor; the telegraph operator was installed on the premises; and, in short, the branch establishment in the Strand was now to its chief office in the country pretty much what Government House, Calcutta, is to Downing-street, London.

The ascendancy of provincial journalism was now almost assured; but the events which greatly expedited this readjustment form the most interesting portion of Mr. Reid's revelations. Eager to obtain copy wherewith to worthily occupy his wire, the London Correspondent—if we may still call him by that humble title—adopted a course of systematic lobbying; that is to say he button-holed everybody he could safely interrogate in the lobby of the House of Commons. Rebuffed at first by the heads of departments, he tried his hand upon their subordinates; and his success in this direction, we are told, was so complete that even the privacy of the Home Secretary's desk was not proof against his importunity. In 1869 he achieved his crowning triumph. Mr. Gladstone's Government attacked official abuses, and was roundly abused in the London and Provincial Press for its pains. The modern Civil Servant, not content with turning shopkeeper, is, it seems, given to journalism; and, worse than

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all, is not imbued with that reforming spirit which called him into being. The enemies of competitive examinations may find some solace in this. Liberalism had not won supporters among civil servants, who, Mr. Reid assures us, at that time were masters of the provincial press. The reforming Government thereupon made overtures to the *Special Wire* men, and virtually bid for their support. Business is business; and the London representatives of country newspapers were not slow to understand that if they would place the case of the Government fairly before their readers, the Government would in return supply them with authentic information. Thenceforward the provincial press was practically the servant of the ministers of the day. "In a few years time," says Mr. Reid, "there was not a department in the State that did not make use of the provincial press for its own purposes;" and when he adds that some of the best London Letters to the provincial papers are penned by members of Parliament, we may safely assume that these members have had close relations with past or present ministries.

It is not clear from Mr. Reid's narrative which party has been most amenable to the pressure of lobbying, or which of them has shown the greater aptitude for manipulating the country organs; and we cannot supply the information. Nor is this the place to weigh the morality or political wisdom of the transactions. One thing is certain, that a new order of political relationship has sprung up, and that it is primarily traceable to the *Special Wire*. The "new provincialism," as it has been appropriately called, which revealed itself in a most striking manner at the recent elections, is the creation of a public opinion independent of, and largely differing from that of the metropolis. Wire-pulling has henceforward a wider and more literal signification. The London Press is no longer the inspired teacher of the country; the real oracle is the telegraph wire. Its voice has been wayward, and its tones, perhaps, have not been over pure; but people who are lamenting over the discord will, probably, in turn betake themselves to attuning it to their liking. The telegraph is no partisan, and our faith in it as an instrument of peace, of concord, and of catholicity remains unshaken by Mr. Reid's disclosures.

PRACTICAL PAPERS BY PRACTICAL MEN.

ELECTRIC BELLS.

BY W. MOSELEY.

(CONTINUED FROM PAGE 65, VOL. IV.)

In previous papers we have endeavoured to prove in detail the inadequacy of ordinary methods of fitting up electric apparatus, except for mere temporary or experimental purposes.

The application of electric apparatus on board ship was cited as the best practical test to which any system could be submitted, and we now fulfil our promise to explain the system—the only successful system—that overcomes the difficulty caused by the too frequent contact of all wires, &c., with salt water.

Some readers who have followed up our suggestions have attached wires and contactor to a piece of wood, the wires being connected so as to demonstrate the action described in explanation of Fig. 2, page 31.

After one momentary immersion in salt water the dissolution of one of the metal springs in the contactor by means of the adhering water during a few hours showed a great waste of battery power, and a similar immersion every day for ten days completely ruined the contactor. A similar experiment with a contactor that we shall describe will show what simple means will remedy great evils in these matters. The tests of the wire insulation correspond to the description we have already given.

Having forewarned the builders of the magnificent fleet of White Star steamers, that the wire and apparatus used in houses would not stand on board ship, the first few voyages of the Oceanic, the ill-fated Atlantic, and the Baltic, proved a fruitful term of experiment. The sudden and frequent changes of temperature and broad alternations of salt-wetness and dryness, made it impossible, with any of the best insulated wires, to keep the "main" wire ("positive") sound. The resort to the protection of metal pipes was compulsory, but unless the pipes could be kept dry inside, additional mischief must attend the use of them. The problem was simple enough, but the difficulty of making permanently sound joints had proved insurmountable in various hands during years of trial in Indian telegraph lines. The following method suggested itself to us, and having proved it to be thus far infallible we will explain it by Figs. 5 and 6. A, A′ are metal tubes containing the wires B B′, the socket *c* is of wood, ebonite, or porcelain, B^2 is a branch wire *not* protected by metal tubes. The tubes being dry, and the ends of the wires being twisted and soldered together, a composition of, say, copal varnish and linseed oil is poured into the socket, filling up the spaces D, D, D, D. As soon as the mixture begins to trickle through—or in about five minutes if none drops—the screw cap C′ is then filled with the mixture, and screwed on, and the socket filled up with mutton suet or other fatty substance. It will be seen that, without any accurate fitting or extra skill on the part of the fitter, the tubes must remain dry inside, however much damp or wet may surround them. With the wires secured by this method and attached to contactors (hereafter described) at one hundred and sixty-eight places on board the ss. Celtic, the battery remained under lock and key and seal for fifteen months, and still every bell and indicator acted perfectly with four smallest Leclanché cells, which was a certain proof that there had been no appreciable loss of insulation at any time. Greater results than this have been observed, but not under formal inspection. Indeed, a careful consideration of the system should convince any one that the tubes being sound and dry inside at the time the mixture is put into the sockets, it does not matter whether the insulating material be india rubber or gutta percha, the virtue of each being equally well preserved, owing to the prevention of dissipation by the hermetic sealing at each end of every section of tubing.

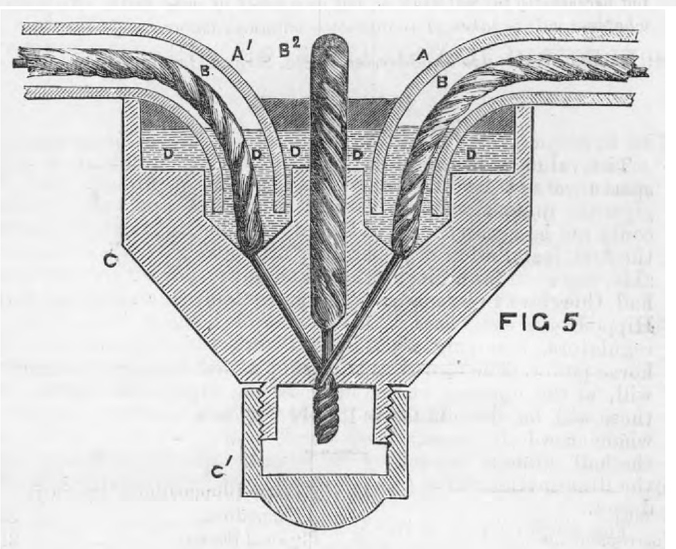

FIG 5

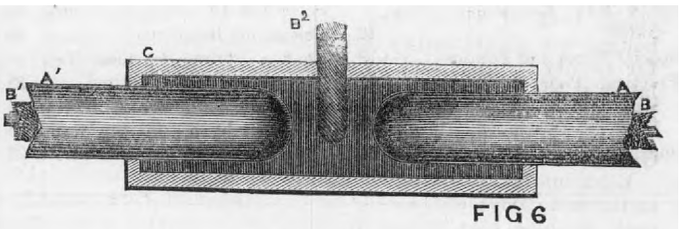

FIG 6

By *slight modifications* of the method as described it is adaptable to all purposes where good insulation is important. The merest tyro in electrics of any kind knows that in dry air almost anything non-metallic will insulate metal conductors. Therefore, *whatever will keep out damp will keep insulation.*

The system recently adopted by the Western Union Telegraph Company in America (Brook's Patent)—and now reported to be under trial between Paris and Versailles—seems to be a partial adoption and partial evasion of the system above described (patented in 1873). The difference in Brook's patent consists in filling the tubes containing the wires with mineral or other oil. Hence any oil being a worse insulator than dry air, the comparison should be guided by the problem as to which practically best attains the one simple object, viz., keeping out the water. If in Brook's system the joints of the pipes are

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perfect, the damp or water would be kept out whether they were filled with oil or not, and, if the joints are *not* perfect, then away goes the oil by reason of its own weight and liquidity, and its place must, in most cases, be immediately occupied by damp air, and at intervals by water. Therefore the question is, which method of sealing up the ends of each section of pipe best adapts itself to the exigencies of place, time, skill, and cost?

(TO BE CONTINUED).

ELECTRIC ILLUMINATION OF THE PARIS HIPPODROME.

(Translated from *La Nature*.)

The value of the electric light for the illumination of large spaces cannot be questioned, and the Hippodrome, with its gigantic dimensions, constitutes a field of application which could not be ignored. As in the case of the Magasins du Louvre, the first installation of apparatus, although somewhat considerable, was soon found insufficient, and entirely fresh arrangements had therefore to be made. The present electric lighting at the Hippodrome comprises 120 Jablochkoff bougies and 21 Serrin regulators, requiring when in full work the expenditure of 160 horse-power. The electrical workshop at the Palais de l'Industrie will, at the opening of the next Salon, supply 365 lights, but these will be distributed in greater or less numbers amongst a whole crowd of comparatively small rooms. At the Hippodrome, the hall alone is lighted by 100 bougies and 20 regulators; and the illumination is the grandest and most powerful hitherto produced.

The employment of two different systems, viz: bougies and regulators, necessitates the use of two different kinds of machine, both of which were devised by M. Gramme. The 120 bougies are maintained by three alternate-current machines, each for twenty bougies, and by a machine for sixty bougies. The latter is the largest "dividing" machine hitherto constructed, but differs from the others only in its dimensions and power. The regulators are each kept in action by a continuous-current Gramme machine.

Each continuous-current machine can work only one regulator at the same time; but, by the aid of a commutator, the light from each machine may be sent successively in several directions to illuminate different portions of the hall according to the exigencies of the performances. For the chariot races and the equestrian exercises, the outer regulators are lit up; for the ground performances the machines supply the regulators placed to illuminate the centre of the enclosure; whilst for the aërial performances another arrangement for lighting is adopted. Even the youthful and daring person who holds on to a chariot by her teeth whilst sliding along a wire from the summit of the Hippodrome has a special light to illuminate her giddy descent through space.

All these changes are effected with remarkable rapidity and facility. Another arrangement results in an economy of plant; the machines for the regulators have no return wire to complete the circuit, but are connected to earth, or rather to the iron framework of the building.

The dynamo-machines are arranged on a series of steps, and each of them is furnished with a separate band, although the motion is communicated to a number of them by a single prime-motor. By this means the velocity of each machine is independent of that of the other machines, and may thus be varied according to the distance which separates a lamp from its electrical generator. For this purpose, all that is necessary is duly to vary the diameter of the pulley belonging to each machine.

The "dividing" machines are those on the Gramme system giving alternate currents. The coils are arranged in four circuits, each supplying five bougies. These machines perform 660 revolutions; their inductors are excited by a Gramme machine of the same type as that for the Serrin regulators (workshop type); this exciting machine having a velocity of 600 revolutions per minute.

The sixty-light machine works twelve circuits with five lights each, moving with a velocity of 540 revolutions; its exciting machine performs 1,100 revolutions.

Whilst the three twenty-light machines require an expenditure of sixty horse-power, it is found by M. Geoffroy, the chief engineer for the electrical service, that the sixty-light machine does not absorb more than fifty horse-power. We see here the advantage of employing powerful instead of smaller machines.

The total power expended varies between 160 and 170 H.-P. This is supplied by two steam engines of the compound type, each of 120 H.-P. Two pulley-wheels of 2·6m. diam. transmit, the motion to two intermediate shafts, by means of india rubber driving bands 40 centimeters in breadth; this intermediate shaft carries a drum over which pass the horse-hair bands which transmit the motion to the electrical machines.

Three boilers, each of sixty H.-P., complete the plant. Nothing can be more animated and interesting than this electric factory when the performance is going on, and when everything is working, and everybody is at his post.

The going-out of the fires, which at first frequently happened, is now of rare occurrence.

There remains something to be said as to the question of cost, which in this case is of great importance.

The electric lighting of the Hippodrome, the brilliancy and beauty of which is beyond question, costs, everything included, from 250 to 260fr. per night. The lighting by gas as effected some years ago cost from 1,100 to 1,200fr., producing a somewhat mean effect.

Here, then, is an application of considerable importance, in which the superiority of electric lighting is unquestionably manifest from every point of view.

It is to be observed, however, that this considerable advantage in point of cost would not be found to exist in a comparatively very small application of the electric light; in this case the advantage would undoubtedly be on the side of the gas.

In order that the success of the electric agency should not be compromised a prudent course of action is necessary, and the field of its applications should be extended only as improvements become developed. Without entering into competition, gas and electricity may thus supplement each other, each finding a sphere in which its disadvantages are inconspicuous and its advantages clearly evident. E. HOSPITALIER.

SOME NEW BATTERIES.

The improvement of batteries is an important branch of electrical progress which ought not to be lost sight of in the prevailing diversion in favour of dynamo-electric machines. The nickel battery of Mr. Thomas Slater is one of the latest novelties, and one of its advantages consists in the fact that the salts of nickel formed during its action are saleable products. In this battery a nickel plate is used in combination with a carbon or a platinum plate, the nickel being the oxidised metal, corresponding to zinc in the ordinary Daniell or Leclanché cells. These plates may be employed either in connection with a single liquid or with two or even three liquids separated by a porous diaphragm.

One kind of cell on the three liquid principle is made by taking a cylindrical vessel containing two concentric porous diaphragms, the outer of which is half an inch wider all round than the inner one. In the centre diaphragm is placed a plate of nickel, which may be cylindrical and either smooth, crimped, or grooved to give a large oxidising surface. This plate is immersed in the oxydant, which may be either sulphuric, nitric, or hydrochloric acid diluted with water in the proportion of one part of acid to eight parts of water. The space between the two diaphragms is filled with a solution of sesqui-carbonate of ammonia, and in the outer vessel is placed a solution of suphate of nickel, or the double sulphate of nickel and ammonia with prisms or plates of carbon plunged in it, or such metal as will take up the deposit of metallic nickel yielded by the decomposition of the nickel solution, after the manner of the copper sulphate in the Daniell cell.

In order to keep the battery in continuous operation by strengthening the oxydant, Mr. Slater arranges two reservoirs, one above the battery and another below it, and both connected with the battery by suitable pipes. The upper reservoir is partially exhausted by an air pump on filling it; and the oxydant flows from it to the cells and thence to the lower reservoir. There it is strengthened by the addition of fresh acid, and returns to the upper reservoir in order to pass to the cell as before. By simply exhausting the air from the upper vessel Mr. Slater is able, through the atmospheric pressure acting on the fluid in the lower reservoir, to cause it to flow into the upper one of itself, and thus he avoids any spilling or wasting of the excitant; and by means of a stop cock attached to the upper reservoir, he can at will allow the atmosphere to enter and force the liquid on its way to the cells. This plan is a modification of the "perfluent" arrangement patented by Mr. Staite in 1848 for the production of constant currents.

Another battery, invented by Mr. T. J. Howell, consists of three separate chambers likewise. There is first an outer vessel of glass or earthenware, next a vitreous cylindrical chamber perforated with parallel slots vertically, and termed a separator, then inside that a porous chamber or cell, thus forming the three compartments.

The outer compartment, or that formed by the walls of the

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outer jar and "separator," contains a rod or plate of carbon, surrounded with ordinary peroxide of manganese and broken pieces of charcoal or graphite, as in the Leclanché battery; but in addition to this there is added a quantity of sulphate of manganese, commercially known as "white manganese." For purposes of transport this chamber may be sealed over with marine glue, or pitch, taking care to prevent a vent hole for the escape of the gases generated, as in the ordinary Leclanché.

In the middle compartment, formed by the slotted "separator" and the porous cell, a solution of sulphuric or nitric acid and water is poured. This passes through the slots and permeates the mixture of carbon and manganese in the outer compartment; but the slots are fine enough to prevent the carbon and manganese from passing into the middle cell.

Within the inner cell is placed a rod or plate of zinc provided, like the carbon plate, with suitable binding screws for connecting purposes. This rod is amalgamated with mercury, and a pool of the mercury is left in the bottom of the chamber. To maintain the amalgamation, a solution of hydro-sulphate of ammonia and water is filled in around this plate. Or, instead of placing the sulphuric or nitric acid solution in the middle compartment, it may be placed inside the porous cell, and the solution of hydro-sulphate of ammonia placed in the middle compartment; but the former arrangement is preferred.

Mr. Howell's battery is, it will be seen, a modification of the well-known Leclanché cell; but apart from the novel shape, and the use of the slotted "separator," it differs from the usual Leclanché in employing "white manganese" in combination with the black, a circumstance which is held to keep the connection between the carbon plate, and the surrounding packing more perfect than in the case where black manganese alone is used. Another advantage of the arrangement is that the porous cell can be removed for cleansing purposes more readily than when it is embedded in the manganese and carbon fragments. By this means the salts can be washed from the pores of the cell, and the internal resistance kept low.

Some years ago Dr. Alexander Muirhead patented a modification of Leclanché's cell in which the porous diaphragm was replaced by a vitreous diaphragm pierced with small holes; but, if we are right, this device did not succeed very well, because of the particles of carbon washed by the solution into the inner chamber, causing a considerable amount of local action on the zinc plate. By the use of the porous diaphragm in addition to the slotted partition Mr. Howell entirely prevents this defect.

A somewhat curious battery has been devised by Colonel Fitz-Charles McCarty, of the Rue Lafitte, Paris. In this cell the positive plate is zinc, and the negative plate is a composition of 20 per cent. by weight of iron filings, 25 per cent. of plumbago, and about 55 per cent. of powdered coke or coal. These three ingredients are well mixed and moulded into proper shape.

The plates are immersed in a liquid composed of about 75 per cent. of salt water by weight (sea water will answer), 3 to 5 per cent. of bichromate of potash, 10 per cent. of vinegar or dilute sulphuric acid, and 10 per cent. of mineral oil—say petroleum. The mineral oil swims on the top, so that when the plates are plunged into the liquid they receive a coating of oil which penetrates the pores, and, according to Colonel McCarty, prevents the hydrogen from entering the latter.

Another bichromate of potash cell is worthy of mention. It is the contrivance of M. Adèle Ergström, of Paris, and consists of two nearly semi-cylindrical cells placed face to face at a little distance apart within a cylindrical vessel of glazed earthenware, which contains the exciting liquid. Each of the semi-cylindrical cells is divided by a partition parallel to its straight face, which face, as well as the partition, the front part of the sides, and the bottom of the cell, is of porous earthenware, the cylindrical back portion behind the partition being glazed, but pierced in the case of the one cell with a number of holes, and in the case of the other cell with a single hole at a high level. The portion of the former cell in front of its partition receives a slab of zinc, and that of the other cell receives a slab of carbon; the spaces in the cells behind the partitions hold the materials for feeding.

The usual materials are employed to excite the battery, namely, bichromate of potash solution and sulphuric acid diluted with water. The bichromate is placed in the feeding compartment behind the zinc, and the acid in the feeding compartment behind the carbon, not quite up to the hole which has been mentioned.

Instead of a slab of zinc granulated zinc may be employed, portions being fed into the cell from time to time as required. In this case a little mercury is placed at the bottom of the cell, and the conducting wire is carried down to the mercury, being insulated where it passes through the zinc lying above the mercury.

For the production of a constant current of moderate strength the elements are placed as above described—the carbon close to the acid and the zinc at a distance from it, and separated by the partition from the bichromate. When a current of considerable strength is required the positions of the zinc and carbon are exchanged, the zinc being thus brought close to the acid. When a weak current of long duration is required, only small portions of the surfaces are made porous. The power of varying the strength of the current at will is one of the special features of this battery.

A more novel battery is, however, that of Mr. Adolph Gutensohn, in which a solution of the sulphate, nitrate, chloride, or chromate of tin is used in the chamber containing the negative plate. Thus pure metallic tin is deposited which may be reduced to ingots by melting in the ordinary way. To ensure that, the tin is deposited in a crystalline and not a "spongy" form; the solution should be of considerable strength. One advantage of this battery is that some of the residue of tin mines, now considered waste, may be utilised in forming the negative solution. In this case Mr. Gutensohn prefers to employ chloride of tin. The particular form given to the cell differs little from the ordinary one. An outer jar contains a cylindrical porous chamber. Surrounding the porous chamber is the carbon plate made in the form of a split cylinder. The solution of chloride of tin filling both compartments of the cell is fed by crystals of the salt contained in the porous chamber, and a deposit of pure tin is formed on the carbon plate.

PHYSICAL SOCIETY.

The annual holiday meeting of this society was held on May 22 at Cambridge. On arrival there the party partook of luncheon in a hall of St. John's College which had been kindly arranged for the purpose by the college authorities. Professor W. G. Adams occupied the chair, and Mr. Warren de la Rue proposed a vote of thanks to the master and senior fellows of the college for providing the hall. The vote was heartily accorded by the members, and after some remarks from Professor Adams the party proceeded to the Cavendish Laboratory, where Lord Rayleigh, vice-president of the society, presided. The routine business of the meeting being waived, Lord Rayleigh described a plan for limiting the slit of a telescope so as to alter the angular interval with which it can deal. The interval is measured by means of a grating formed by winding a fine wire round two parallel screws of very fine thread.

Mr. SHAW exhibited a modification of Veinholdt's apparatus for distilling mercury, by which a kilogram of mercury can be distilled per hour.

Mr. SYDNEY TAYLOR exhibited a device for showing the motion of the particles of water in the transmission of a surface wave. Sixteen discs were arranged in single file, each having a white spot on its face, and on turning a handle the discs rotated so that the spots which represented particles of water moved so as to present a wave motion to the eye. Mr. Taylor also showed a manometric flame apparatus for exhibiting to the eye the difference of phase between two musical notes. This consisted in two bent tubes into which the notes were sounded, and capable of being lengthened or shortened by hand like the pipes of a trombone. Opposite the ends of each of these tubes a sensitive flame was placed, and a rotating mirror showed the disturbance produced in the flames by the two different notes. A third flame exhibited the joint effect of the two notes. When the tubes were silent the images of the flames on the revolving mirror were seen as plane bands, but when notes were sounded into the tubes they became serrated, and the serrations were like or unlike, according as the phases of the notes were like or unlike.

Mr. POYNTING exhibited a plan for altering the plane of polarisation of the two halves of a pencil of rays from the polariser, so that half the field may be made to appear dark when the other is bright, or both of equal brightness, at will.

Mr. GLAZEBROOK described a method of measuring the rotation of the plane of polarisation of light by means of two spectra giving dark lines made to coincide.

Lord RAYLEIGH described a plan for demonstrating that yellow colour can be formed by combining red and blue together. He mixes a red solution of chromate of potash with a blue solution of litmus, and on filling it into a glass cell of a certain thickness the light transmitted through it is seen to be yellow. Plates of glass coated with gelatin impregnated with litmus, and gelatin impregnated with chromate of potash, and placed side by side, also transmit yellow light. Lord Rayleigh finds, however, that the eyes of different persons vary considerably in their power of appreciating the tinge of the transmitted yellow; one deeming it greenish, another reddish, while a third considers it pure yellow. This peculiarity is not to be confounded with "colour blindness," since all three persons would distinguish the red and green components accurately. Lord Rayleigh also exhi-

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bited a colour box, based on the Newtonian principle, first carried out by the late Professor Clerk Maxwell, but of a small size.

Sir W. THOMSON then proposed a "Vote of Thanks to Lord Rayleigh," which was seconded by Professor W. G. Adams, and the meeting then dispersed to examine the apparatus and appointments of the Cavendish Laboratory.

SOCIETY OF TELEGRAPH ENGINEERS.

MAY 26.

A DECADE IN THE HISTORY OF ENGLISH TELEGRAPHY.

BY E. GRAVES, ESQ.

When the idea of this paper was first suggested to me, I had intended to cover a much larger field than that I shall occupy by my remarks this evening.

In popular estimates of the progress of telegraphic communication, it is usual to consider only the development of the electric agent as applied to the exchange of ordinary messages between individuals, and for the service of the Press—in other words, the commercial telegraph. It is sometimes overlooked that the multiplication of railway trains is made possible, and that their speed can safely be allowed to reach its maximum.

In 1837, Cooke and Wheatstone's five-needle telegraph was tried successfully, on a small scale, by the London and Birmingham Railway Company, near London.

Subsequently it was tried by the Great Western Railway Company between Slough and Paddington, and its use gradually but rapidly extended over most important trunk lines.

Commercial telegraphy was, as it were, grafted upon railway telegraphy. The two grew together.

In 1846 the first telegraph company properly so called was incorporated—the Electric Telegraph Company.

The Telegraph Company was allowed to erect separate lines of poles and wires for itself on railways, and to avail itself of the services of the clerks of the latter in their spare time.

When the telegraphs were transferred to the State, one of the earliest duties devolving upon the post-office was to disentangle itself from numerous agreements of the character indicated; and, unfortunately, this involved liberal compensation to the railway companies for all that they had lost, without any corresponding allowance for what the department, as heir of the telegraph companies, had surrendered. As time went on, it was found that telegraph companies might subsist without the aid of railways.

Twenty years ago a telegraph engineer or superintendent had to interest himself, not only in the business of conveying commercial telegrams, and to consider the cheapest and most efficient means by which he could perform this service for the public, but he had also to study the needs and peculiarities of railway traffic.

THE PROGRESS OF COMMERCIAL TELEGRAPHY.

I have already stated that in 1846 the first telegraph company in England was incorporated.

A few years later, I think in 1850-51, the British Telegraph Company, the European Telegraph Company, and the Magnetic Telegraph Company all came into existence. After various vicissitudes, these companies, or what remained of them, amalgamated under the name of the British and Irish Magnetic Telegraph Company. This was in 1857.

Later still, in 1860 or 1861, the United Kingdom Telegraph Company, which had been projected many years before, assumed a real existence. This company differed from the former companies, inasmuch that it was wholly unconnected with railways.

About 1861 another field of telegraphic operations was tapped on a considerable scale for the first time—the Universal Private Telegraph Company was started. Prior to that time, private wires, *i.e.*, telegraphs for the exclusively private service of certain individuals or associations, had been erected by the different companies existing; but this company commenced with the distinct object of laying itself out to construct wires soley for private use—from the offices of firms to their workshops, and the like.

In 1869 there were existing in the United Kingdom no less than twenty-nine separate undertakings specially devoted to the transmission of telegraph messages, wholly independent of railway companies, who employed their wires secondarily for the same purpose.

There were certain railways which were carrying on telegraph business on a comparatively large scale.

At length an agitation arose in favour of the control of the telegraphic communication of the country by the State. It culminated in a measure, passed in 1868, authorising the post office to buy up and extinguish existing interest in commercial telegraphy. The Telegraph Act of 1868 did not contemplate granting a monopoly to the post office. Mr. Scudamore did not ask for it. However, before the Money Bill to make good the purchase was authorised in 1869, the political authorities had determined that a monopoly of the right of sending telegrams for money was necessary, and it was therefore acquired.

In 1869 the lines of telegraph available for public use extended from Penzance to Wick, and from Lowestoft to Galway. In fact, the succeeding ten years have only carried them on to Scilly and the Shetlands, so far as regards the main north and south routes. But while the country was traversed by electric lines, it was not covered by them; they were very widely severed in some districts. Whole counties were dependent upon a single thread of communication, and towns far from a railway were in many instances utterly ignored. The telegraph had penetrated to places where commercial activity was rife, and whence profits could be drawn, but it had not been utilised for the benefit of rural districts, nor had it as a rule been established where commercial success could not be reckoned upon. In fact, the only chance of finding a telegraph office in a village was in the event of its also being a railway station where there was a telegraph available primarily for railway purposes, or of a trunk road line passing through to some large seat of commerce, upon which the company had established an intermediate office. In 1879 the country is almost uniformily dotted over with telegraph offices. Commercial considerations alone have not been kept in view, and telegraphic facilities have been given in many instances to very small communities far from any commercial centre. In 1869 the total number of telegraph offices was 2,488, railway stations open for telegraph business included. In 1879 it had reached 5,331.

In 1869 the total number of messages transmitted by the companies was from 6,000,000 to 6,500,000.

The total number of messages transmitted over the English land lines in 1879 (more exactly for the financial year ending 31st March, 1880) was 26,547,137, being an increase of more than fourfold over those of the corresponding period of ten years ago. In 1869 the total number of miles of wire used exclusively for commercial traffic was under 50,000, some part of which length was by the provisions of the Acts of 1868 transferred to railway companies upon the acquisition of the telegraphs by the State, and does not now count as commercial wire.

In 1879 the mileage of Post Office wires used for commercial traffic, existing on railways was 54,067 miles.

Existing on roads and canals	46,784	,,
Existing in the local submarine cables	1,805	,,
	102,656	

This mileage also was supplemented to some extent by the use of railway wires, which, under various arrangements, are still available to the public. In 1869 the number of instruments fixed upon commercial wires, and used to work them, was as nearly as can be ascertained about 2,200. In 1879 the number was, of various kinds, 8,151. On this point I may mention that the increase in the capacity of the instruments employed, *i.e.*, their average power of transmitting messages, is far greater than that of their numbers. In 1869 there were, for example, two Wheatstone automatic circuits existing in Great Britain—one London to Manchester, one London to Glasgow—worked of course by four instruments. In 1879 there were 173 such instruments employed. In 1869 no duplex instruments existed. In 1879 there were 392 employed. This means, in effect, that wires formerly worked by ordinary instruments had been practically doubled in numbers by the adoption of the duplex system. In 1869 quadruplex of course had not been thought of. In 1879 there were six circuits worked by that invention, making the six wires equal to twenty-four in carrying capacity. In 1869 no sounder instruments were employed. In 1879 there were 1,374 of these instruments in use, the result being that an equal number of Morse printers were dispensed with.

When Sir Charles Wheatstone brought his automatic instrument to the Electric Telegraph Company in 1866, it was only possible to work it at the rate of about 55 to 60 words a minute if a wire of No. 8 gauge was employed, increasing to 80 words a minute if a wire of No. 4 gauge were used: this over a circuit about 280 miles in length. In 1879 it was possible to work for distances of 300 miles with No. 8 gauge wire at over 200 words a minute, and regularly and in all weathers at 130 words.

Continuing the details of the available means of communication, I may mention that in 1869 the length of internal submarine cables, *i.e.*, of those connecting England and Ireland and the various outlying islands, wholly independent of those uniting this country to the Continent, was about 121 knots, the total being made up of 18 separate cables. In 1879 this total had grown to 614 knots, including 58 separate cables, containing from one to seven conducting wires respectively.

(TO BE CONTINUED.)

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TELEPHONIC REPORTING.

The Times of May 27 contains an article describing the system of telephonic reporting adopted by that Journal, in order to have the latest and fullest report of the speeches made in the Houses of Parliament. Permission having been obtained from the Metropolitan Board of Works to lay down the necessary wires in the subway of the Embankment, a new connection between the House of Commons and *The Times* office was formed, and one of Edison's loud-speaking telephones placed at either end. The immediate result of this arrangement has been to bring the compositor at the machine into direct communication with the Parliamentary Reporter at the House, and to enable the debates to be reported and printed from half to three-quarters of an hour later than had previously been possible. The notes made by the reporter can be read directly into the telephone receiver in a room adjoining the gallery either by the reporter himself when relieved or by another person employed for the purpose; and the compositor, at his machine in the office, sits with his ears in juxtaposition with the other terminal of the instrument. The plan which has been found the most efficacious for the purpose of shutting out distracting sounds of other kinds is to place the disc of the telephone above and behind the conpositor, and then to arrange two tubes, each with two trumpet-shaped extremities, in such a manner that these extremities are applied at one end to the two sides of the telephone disc and at the other end to the two ears of the compositor. The compositor is also furnished with a speaking instrument, with a key for ringing a bell, and with a bell which is rung from the House; a simple code of bell signals, consisting of one, two, or three strokes, sufficing for the ordinary requirements of each message. The compositor announces by the bell that he is ready, receives a sentence, strikes the bell to indicate that he understands it, sets up the type with his machine, strikes the bell again for the reader to continue his dictation, and so on until the work is carried as far as time will allow. If there is any doubt or difficulty about the words, a bell signal will cause them to be repeated, or explanations can be sought and received by direct vocal communication. In this power, indeed, resides one of the chief advantages of the method, and one which ought to lead to greater accuracy than has ever previously been attainable. The names of people, places, &c., can be spelt out letter by letter if there is any doubt about them.

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY (LIMITED).

The second ordinary general meeting of the shareholders of this Company was held on the 25th inst., at the offices, Old Broad-street, Mr. John Pender, M.P., the chairman of the Company, presiding.

The SECRETARY (Mr. William Payton) read the notice convening the meeting, and the report of the directors was taken as read. It stated that after setting aside a sum of £1,200 for the reserve fund, and charging the interest on the debentures, the accounts showed a net revenue for the nine months ending the 31st of March last of £5,480 to which was to be added the balance of £5,719 carried forward from July last, making a total of £11,200 to the credit of revenue account. They recommended the declaration of a dividend of 2s. 6d. per share, free of income tax, which would absorb £4,768, leaving £6,431 to be carried forward, pending the collection of the debt due from the Uruguay Government. As indicated in the circular sent to the shareholders on 30th January last, the transfer of the assets and property of the company from the Brazilian company to the English company has been completed, and nearly all the shares have been sent in for exchange and certificates of the English company issued to the shareholders. In consequence of the provision of the Articles of Association that the general meetings of the Company should be held in May, it had been found necessary to make up the present accounts for a period of nine months. In future an interim half-yearly dividend would be declared by the board, and the yearly accounts would be made up and presented at the general meeting in May, when a final distribution would be made. The Company's submarine and land lines were in good order.

The CHAIRMAN, in moving the adoption of the report and accounts, and the payment forthwith of the dividend recommended, said that the report went very fully into the position of the Company, and the accounts he thought were put before them in such a form as would be perfectly intelligible to them all. That was really their first meeting since the Company had been constituted an English company, and they might say that they now had the affairs of the Company under the immediate control of the present board. The previous meeting was not an ordinary, but rather a formal one. The resolutions passed at two extraordinary meetings were printed and circulated, and, therefore, it was, perhaps, unnecessary to print them. The report spoke as to their prospects, and he thought that, looking to the improved position of the Western and Brazilian Telegraph Company, that this Company's prospects were decidedly better. It appeared that they were to get something like £20,000 this year as against £17,000, which was the average in the previous two years. They had also a telegram from their agent abroad to the effect that £1,000 had been remitted, but they did not know whether that was for the reduction of the Government debt or whether it was made up of current receipts—probably it was a mixture of both. At all events it was £1,000, which gave evidence of more vitality there than had existed for some time past. If the Government would only keep up to the mark and pay the Company for what they did for them their earnings would show a very much better result; but, unfortunately, their arrangement with the Government was such that they were really obliged to carry on the traffic whether the Company were paid or not, and they were subject very much to whether the Government had the means to pay them or not. At all events they had shown a fair disposition, and he believed that if General La Torre had been maintained in his position they would have had a very fair and honest man to deal with so far as the means at his command allowed. They were keeping their case constantly before the Government, and they hoped that by pressure they would get more out of them in the future than they had done in the past. If that arose it would be in a great measure from affairs now being really under management and under something like a board who made it their business to see that the interests of the Company were protected. He was afraid that before they were taken up in a spasmodic way, and that they had no real attention given to them. Hence the Company drifted into a great deal of trouble. Another cause of that state of things was that though the management was said to be in England the board was in Brazil, and divided action like that really led to no good results. The earnings of the Western and Brazilian Company had shown a very considerable increase, though they had fallen off in the last few weeks, but telegraphs fluctuated more or less according to the state of trade; in fact, he knew of no interest more affected by the ups and downs of commerce than the telegraph interest. He hoped that they might now look forward to better times, with the result that this telegraph system would benefit materially. He might mention that other telegraph systems with which he was connected had shown very considerable vitality indeed, and that even now they had not suffered anything like what they might expect. Since the directors came into office the revenue of the land lines had shown a steady growth, and, as he said before, if they could only get the Government to pay their amount this item would be satisfactory. About twelve months ago they revised the tariff, and the result had been satisfactory so far. They were obliged to have a reserve fund, and the other day they invested £4,550 in Metropolitan Board of Works Stock. They always found it was better to put such investments into a stock as near to the funds as possible—any stock which they could realise promptly if required, and this stock, he believed, was considered one of the very good investments of the day. They had a few Western and Brazilian shares, and lately change of management and other things caused them to go up considerably, and as the amount was very trifling they thought it was well to realise the greater portion of those shares, merely retaining a few to enable any director of the Company to be present at the meetings of the Western and Brazilian Company if necessary. They had added the amount realised to the reserve fund. He might say that the present directors had carried out the promise they made when they first took the thing in hand—first that they would endeavour to make the Company an English company, and to bring the management entirely to London. So far that had been carried out successfully; and with the plain and distinct accounts before them, with evidence of what the Board intended to do in the future, his hope was that they might now see their way, not to great things, but to a moderate return on the capital invested. He thought it right to say that the capital invested in this concern was largely in excess of what it ought to have been. He believed at the present moment that with half, or perhaps less than half, the capital they could have the same works that they had at the present time. He concluded by moving the resolution.

Mr. JOHN HOLLOCOMBE seconded the motion.

The CHAIRMAN, in reply to Mr. Sanderson, said that the accounts were made up for nine months both in London and America.

Mr. SANDERSON said he observed under the item of capital in the balance sheet these words—"800 of the above shares issued (representing 400 shares in the original Company) are held by the Company as guarantee for contract with Messrs. Lamas and Co., dated July 24th, 1872, and in respect of these the Company has received and holds 100 shares in the Western and Brazilian Telegraph Company." He found, however, on the other side of the account that they owned 119 shares of the Western and Brazilian Company. He commended the directors for the trouble they must have taken in connection with the conversion of the undertaking into an English company.

The CHAIRMAN said that they did not attach much importance to Lamas and Company's account. They had these 100 shares as belonging to Lamas and Co., but it was an account which was not yet settled. The shares on the other side, however, were those which belonged to the Company. The 800 shares had these 100 attached to them, and they would remain in that position till the question of Lamas and Co. was settled. The other shares, as he had said, were theirs. They had sold 119, and they retained 100 to enable them, if necessary, to attend the meetings of the Western and Brazilian Company.

The report was then unanimously adopted.

Mr. FRANCIS PAVY next moved the re-election of Mr. Pender. When he (Mr. Pavy) first became acquainted with the undertaking it was almost in an absolute state of chaos. The shareholders did not know where to go and get any information concerning the Company. He felt that such a state of things ought not to exist, and it was asked to get their position remedied. He put himself into communication with Mr. Pender, knowing the great knowledge he possessed of all telegraph matters, and it was with considerable difficulty that he got that gentleman to take matters in hand. Once having put his shoulder to the wheel, Mr. Pender had stuck to it ever since, and it was due to him that they were in their present position, and that they had the advantage of the services of Mr. Hollocombe, whose acquaintance with Brazilian matters was very great. They had constituted the undertaking an English company, and got a quotation on the Stock Exchange, and instead of their £20 shares being hawked about and selling for £6 they could now be readily sold for £12.

Mr. SANDERSON seconded the motion, and it was carried unanimously.

The CHAIRMAN, in acknowledging his re-election, said that there was no question that the Company was formerly drifting into no man's land, whereas it had at all events been put on a sound footing, and he thought they were probably in such a position that they would be able to do a little more than they had done. There were other companies existing on the coast, and he thought they might at all events try whether they could not make this small Company a bigger one, and, if it were to the interests

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of the shareholders generally, see if they could form a large partner in a combination. He believed in these combinations, particularly in telegraphs. It was a system which must be fed to a very great extent, and the more they could work in perfect harmony, he believed the better the work was done, that the expense was smaller, that the public were better served, and that the shareholders were more largely benefited. They had that object in view, and he hoped that ultimately the Company might merge into something more important.

A resolution was then proposed and seconded for the re-election of Messrs, Deloitte, Dever, Griffiths and Company, as auditors of the Company.

The CHAIRMAN, in putting the motion, said that he knew of no gentleman who better understood the accounts of such companies than Mr. Griffiths, who represented his firm, and it was a very great satisfaction to him always in all telegraph affairs to know that they had the accounts in hand, as they so thoroughly knew that class of business. The motion was carried unanimously.

A shareholder asked if the £900 on the debtor side of the account for directors remuneration was for nine months.

The CHAIRMAN said that it was, and

The SECRETARY said that the directors' remuneration was fixed at £1,200 a year in the articles of association. It was the same as was paid to the old directors.

A vote of thanks was then passed to the chairman and directors.

The CHAIRMAN, in reply, said that he hoped that when he next addressed them they would be able to present better accounts than on that occasion. They were now in view of a better state of things, and he hoped it would come speedily.

The proceedings then terminated.

ABSTRACT OF PATENTS.

3476. MICROPHONIC APPARATUS, *W. P. Thompson.—Dated 29th August*, 1879.—(*A communication*). 6*d*.

A thin rigid board is made movable round one of its edges as an axis. At the part opposed thereto is a prism of charcoal or any other mediocre conductor of electricity, upon the anterior face of which are held by flexible springs upon the main board, one, two, or more little fragments of graphite or similar matter. This apparatus is introduced in the circuit of a voltaic battery containing the receiving telephones, or in the primary circuit of an induction coil containing the telephones.

3509. REGULATING MECHANISM FOR ELECTRIC LAMPS, *R. E. B. Crompton.—Dated 2nd September*, 1879. 6*d*.

The controlling of the regulating mechanism is effected by the action on a bar of metal movable in relation to the armature or to the core, of the magnetism induced in the armature when acted on by its own electro-magnet, or in the core of the solenoid when acted upon by its helix. This bar is caused to operate by means whereby the mechanism which feeds the carbons or causes them to approach one another may be retarded or arrested, or *vice versa*.

3525. TELEGRAPHIC RECORDING APPARATUS, *R. K. Boyle.—Dated 3rd September*, 1879. 6*d*.

This relates to improvements on patent No. 5313, dated 30th December, 1878. Several sorts of wire are employed of smaller diameter than the two coils described in above-named patent, and they may be with or without iron cores. These coils are placed one above another, being suitably attached to metal standards, and the coils are in such a position on the standards that each axis is vertical, and consequently the faces or flat ends of the coils are in horizontal planes.

3543. ELECTRO-MAGNETIC INDUCTION APPARATUS, *R. H. Courtenay.—Dated 3rd September*, 1879.—(*Not proceeded with.*) 2*d*.

Four soft iron or soft steel bars are arranged in a square so that the ends are respectively in as close proximity to each other as is possible without actual contact. Upon each bar are mounted two or more bobbins having each two or more primary and two or more secondary coils, the coils being wound in such a direction as to give the necessary polarity to the iron cores.

3565. DYNAMO-ELECTRIC MACHINES, *W. Elmore.—Dated 4th September*, 1879. 8*d*.

End standards with a broad circular surface, and serving as stationary discs, are bolted to a bed plate, such standards having central bosses to carry the main driving shaft, and on the inner surface magnets radially arranged. The shaft carries a pulley at one end and the commutator at the other, whilst between the standards is a disc, upon both sides of which are fixed radial magnets, so as to form a revolving armature. The magnets of both the stationary discs and the armature consist of two soft iron plates of sector form, connected by a solid connecting piece of steel or iron, of corresponding shape, but smaller than the plates, one of which serves as a flange to bolt the magnets to the revolving disc or the stationary disc, and the other acts as the soft iron surface. The connecting piece serves as a core upon which wire is wound. To prevent the current from changing a governor is employed, and is placed at the driving end of the machine, and driven off the driving shaft.

3587. ELECTRIC LAMPS AND SWITCHES THEREFOR, *F. J. Cheesbrough. Dated 6th September*, 1879.—(*A communication.*) 6*d*.

This relates to a means of avoiding the formation of the voltaic arc in a sealed electric lamp, and consists of feeding mechanism in combination with the lamp for the purpose of mechanically feeding automatically the incandescent carbon pencil and maintaining its contact against carbon roller or other device for diffusing the current and continuing the circuit.

3750. ELECTRIC LAMPS, &c., *H. J. Haddan.—Dated 18th September*, 1879. —(*A communication*). 8*d*.

This relates to two or more pairs or sets of carbons in combination with mechanism constructed to separate said pairs dissimultaneously or successively, and establish the electric light between the members of but one pair —to wit the pair last separated—while the members of the remaining pair or pairs are maintained in a separated relation.

3771. ELECTRIC LAMPS, *J. Brockie.—Dated 19th September*, 1879. 6*d*.

A magnet or solenoid is supplied to each lamp in a branch of the main circuit, and a commutator cuts out this magnet momentarily at stated periods. The commutator is worked by engine or electro machine, producing the current, and the effect of this momentary cutting out of the magnet is to allow the carbons to drop together, when they are immediately separated the requisite distance for the development of the arc.

3777. ELECTRIC PENS, &c., *T. Coad.—Dated 19th September*, 1879.—(*Not proceeded with.*) 2*d*.

The pen is suspended and balanced by a crane, the pillar and arm of which are hollow, and through them passes a cord, one end carrying a counterweight, and to the other end the pen is suspended by a gimbal.

3793. PRODUCING AND SUBDIVIDING THE ELECTRIC LIGHT, *J. Harrop.—Dated 20th September*, 1879.—(*Not proceeded with.*) 2*d*.

The carbon points are placed in metallic holders in juxtaposition on the same electrode, which is divided between the points, and to regulate the intensity of the light near the part of the electrode where separated a drum partly of vulcanite and partly of copper is placed, and a comb of copper is so arranged as to be in contact with the copper portion. To produce more than one light the electrode or circuit is divided and the above arrangement repeated.

3794. APPARATUS EMPLOYED IN CONNECTION WITH TELEPHONES, *A White.—Dated 20th September*, 1879.—(*A communication.*) 6*d*.

This relates to the construction and arrangement of electric circuit-connecting board, whereby any two separate electric circuits may be quickly united to form one, and as quickly divided so as to again constitute two distinct circuits.

3858. GALVANIC BATTERIES, *J. Imray.—Dated 25th September*, 1879.—(*A communication.*) 4*d*.

The element consists of two nearly semi-cylindrical cells placed face to face at a little distance apart within a cylindrical vessel containing the exciting liquid. Each cell is divided by a partition parallel to its straight face, which, as well as the partition, the front part of the sides and the bottom, is of porous earthenware, the cylindrical back part behind the partition being glazed, but pierced in one cell with a number of holes, and in the other with one hole at a high level. The portion in front ef the partition in the former cell receives a slab of zinc, and that of the other a slab of carbon, the spaces behind the partitions containing the materials for feeding.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES MAY 26.		BUSINESS DONE WEEK ENDING MAY 26. Highest.	Lowest.
Anglo-American Ordinary	62¼,	¾	62¼	62
Do. "B"	92,	½	92½	91⅞
Do. "A"	34½,	35	35½	34⅜
Brazilian	8⅛,	⅜	8⅜	8⅛
Cuba	9¼,	¾	9½	9⅜
Do. Ten per Cent. Pref.	16,	17	16⅜	16
Direct Spanish	1⅜,	2¼	—	—
Do. Ten per Cent. Preference	10⅜,	11½	—	—
Direct United States	11¼,	½	11⅝	11⅜
Eastern	8 15-16,	9 1-16	9	8⅞
Do. Six per Cent. Debenture	102,	104	102½	102½
Do. Five per Cent. do.	102,	104	102¾	102⅛
Do. Six p Ct. Preference	12½,	½	12½	⅜
Eastern Extension	9 1-16,	3-16	9 3-16	9 1-16
Do. Six per Cent. Deb.	107,	110	—	—
German Union	8¾,	9¼	9	8⅜
Globe Telegraph & Trust	5 15-16,	6-1 16	6 3-16	5⅝
Do. Six p Ct. Preference	11⅜,	12	12	11⅞
Great Northern	9½,	¾	9¾	9⅜
Indo-European	23,	24	—	—
Mediterranean Extension	2⅜,	3⅛	3⅛	3⅛
Do. Eight per Cent. Preference	10⅜,	11½	—	—
Reuter's	10,	11	—	—
Submarine	230,	240	—	—
West India and Panama	1⅜,	⅝	1⅝	1⅛
Do. Six per Cent. Preference	7⅝,	⅞	7¾	7 11-16
Western and Brazilian	6⅜,	7⅛	7 3-16	6⅜
West. Union 7 p. Ct. 1st Mt.	117,	122	—	—
Do. Six per Ct. Sterg.	103,	105	—	—

TRAFFIC RECEIPTS FOR APRIL, 1880.

COMPANIES.	April 1880.	April 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	3,100 estd.	3,140	—	40
Direct Spanish Telegraph Company	—	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	44,748	37,846	6,902	—
Eastern Extension Telegraph Company	24,342	21,060	3,282	—
Great Northern Telegraph Company	18,360	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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SLIP

NEW POST AND TELEGRAPH OFFICES.—The Government of India have sanctioned an additional grant of one lac of rupees for the proposed new post and telegraph offices at Madras. The work is to be commenced forthwith.

DEATH FROM LIGHTNING.—On Friday, May 28th, at Brierly Hill, Joseph Manning, in charge of a horse and cart at Lord Dudley's Cuckoo Pit, was struck by lightning, and killed on the spot. The horse was also struck to the ground and blinded.

THUNDERSTORM.—On Wednesday night, during a severe thunderstorm, a timber willow tree, in the grounds of Mr. C. D. Halford, of East Bergholt, was struck by the electric fluid and shattered from top to bottom. Some of the splinters were hurled a distance of 50 feet.

COMPAGNIE FRANCAISE DU TELEGRAPHE DE PARIS A NEW YORK.—It is notified that this company's lines to America opened for public traffic on June 1, 1880. The London receiving office is at 24, Royal Exchange. The tariff from England to New York is two shillings per word.

ACCIDENT AT LYONS.—A workman met with an extraordinary death at Lyons last week. Having to unfix a wire conducting the electric current for a lighting apparatus he incautiously handled it without his non-conducting india rubber gloves. The current knocked him down insensible, and notwithstanding every medical help he never recovered consciousness.

THE NAME OF THE SOCIETY.—Mr. J. C. Cuff writes from Singapore:—"I beg to suggest that we do all we can to have the name of the Society of Telegraph Engineers changed to 'The Electrical Society' which is concise, comprehensive and euphonious, corresponding to 'The Physical Society,' 'The Chemical Society,' &c., instead of to 'The Society of Telegraph Engineers and Electricians,' which is cumbrous and unsatisfactory."

SALARIES AND ALLOWANCES.—The late Secretary of State for India sent a despatch, dated February 12, to the Government of India, describing the changes which Lord Cranbrook determined to carry out at once in certain Indian salaries and outfit allowances. Among other things, it states "In the case of officers appointed to the Telegraph, Forest, Educational, and Ecclesiastical Departments, a free passage will be granted, but no outfit allowance."

GREAT NORTHERN TELEGRAPH COMPANY.—This company's new station and general offices are opened at 119, Bishopsgate-street Within, E.C., where messages for China, Japan, Manila, Russia, Sweden, Norway, and Denmark will be received. Telegrams for these countries will as hitherto also be accepted at all postal telegraph stations, the company's station being connected by direct pneumatic tube with the Central Post Office Telegraph Station, but the public are in their own interests invited, whenever practicable, to hand in their messages direct at the company's station.

THE LONTIN-MERSANE LIGHT.—The office-bearers of the Chamber of Deputies have paid a visit to the works of the Lontin-Mersane electric light, in order to judge of its applicability to the Palais Bourbon. They expressed great satisfaction with the brilliancy, steadiness, and manageableness of the light, M. Margaine stating that the rapidity of electric improvements had hitherto prevented the Chamber from adopting the electric light lest by the time one system was installed a superior system should have superseded it. There is, however, an impression that gas has influential supporters at the Palais Bourbon.

WAS IT WIND OR LIGHTNING?—A suit has been brought in the Circuit Court at Madison, Wisconsin, to collect from an insurance company for damages done by the great storm of 1878. The property was insured against lightning, and the company resist payment on the ground that it was destroyed by wind. The plaintiff hopes to prove by the evidence of members of the Signal Corps that the whirlwind which destroyed his house was of electrical origin. A vast amount of insurance is likely to be affected by the decision of this case, owing to the heavy losses of property during the recent whirlwinds.

POLO BY THE ELECTRIC LIGHT.—A polo match was played at the Ranelagh Club grounds, Fulham, between members of the Hurlingham and Ranelagh clubs on Saturday night, when the ground was illuminated by the electric light. Three high stands had been erected, and operators with concave reflectors turned the rays of light upon the players as they galloped about the field. The effect as a spectacle was exceedingly picturesque. Hurlingham took the ball through their opponents' goal three times, and lost but one goal on their side. After the match there was an illumination of the grounds and a display of fireworks by Messrs. C. T. Brock and Co. Serrin's light was used.

THERMO ELECTRICITY.—At a recent meeting of the United States National Academy of Science, Professor Langley spoke of an improved thermo-electric apparatus due to a product of the American iron industry. Experiments with a great variety of substances (for measurement of radiant heat) had thus far shown that iron in extreme thinness (cut into strips about one-third of a millimètre wide and 1-500th of a millimètre thick) was the best. The speaker exhibited specimens of iron rolled in the Pittsburg mills, which were so surprisingly thin that from 10,000 to 12,000 sheets laid on each other equalled only one inch in thickness. From these was produced an instrument which had almost the promptness of action toward radiant heat which the eye has towards light, and which had greater sensitiveness than any thermopile.

THE DIRECT UNITED STATES CABLE COMPANY.—This Company has reduced the charge for the transmission of telegrams *viâ* direct cable between Great Britain or Ireland and New York and Canada to *two shillings* per word. The rules applied to messages prior to and since the 1st April remain unaltered. Of course this action has been rendered compulsory in the face of the opposition to be expected from the new French Company, whose notification of opening appears in our notes of this date. We may state that the extraordinary quick rate of sending the result of the Derby to America by cable in 25 seconds, was by the Direct Cable Company. The message announcing the result contained eight words, and was delivered to the press for publication in New York within 45 seconds of the time (3:39 p.m., Greenwich) at which it was handed in at the office.

TELEGRAPHING EXTRAORDINARY.—The *South Australian Register* says:—The superintendent of telegraphs (Mr. C. Todd, C.M.G.) has kindly supplied us with the following information:—On Sunday morning the telegraph lines being clear of business, Melbourne and Port Darwin were put in direct communication with each other, the distance between the two places being 2,500 miles. The signals were perfect at each end, the line working splendidly right through, and the replies were instantaneous. The cable was then cleared, and communications exchanged with Singapore, a further dis-

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tance of 2,200 miles, or 4,700 miles from Melbourne. Replies were received from Singapore in a few seconds, a message being sent and a reply received in the space of one minute from the commencement of the message. The messages had of course to be repeated at Port Darwin, but this was done simultaneously, so that little or no time was lost. Port Darwin and Singapore were in direct communication through the duplicate cable recently laid, which avoids the necessity of using the land line through Java. Since the duplicate cable has been submerged, the time occupied in the transmission of messages between London and Adelaide is greatly reduced, seldom occupying more than a few hours, and from Adelaide they invariably beat the sun, arriving at their destination in advance of the local time they were handed in.

Electricity Superseded in Plating.—Novel Galene-plating Process.—At a meeting just held of the Royal Dublin Society Dr. J. E. Reynolds, Professor of Chemistry in this University, gave some illustrations of a process he has discovered for coating metallic and other surfaces with a brilliant and strongly-adherent layer of galene. The plating of a tube of brass and another of glass was effected at the meeting by simple immersion in a solution which speedily deposited a beautiful mirror-like layer on the material. This layer readily assumed its final polish by friction with a wash-leather, and it bore some severe treatment without giving way. The colour of the deposit is darker than pure silver, but brighter than oxidised silver, and the coated surface can easily be made to assume a peculiar blueish bloom, which enhances its beauty. Dr. Reynolds exhibited a number of specimens in iron, steel, brass, glass, porcelain, ebonite, and other articles, which had been subjected to the action of the atmosphere for a period of more than two months in some instances, and all withstood this severe test completely without showing tarnish or rust. Dr. Reynolds mentioned that the cost of his galene-plating process did not exceed one-eighth that of nickel-plating. Moreover, any intelligent workman could quickly become his own plater, as the use of electricity is altogether avoided. The process had received British and foreign patent protection.

An Electrical Railway Devised Thirty-three Years Ago.—In reference to Siemens' electrical railway motor, shown in action at the Berlin Exhibition in 1879, the *Scientific American*, in claiming *the* Electrical Railway as an American invention, says:—"Our attention has been directed to a similar plan described in the *Scientific American* as long ago as September 25, 1847, which reads as follows:—Mr. Lilly and Dr Colton, of Pittsburg, Pa., have invented a new method of railway propulsion, which is both novel and ingenious. The machine is a small locomotive, and is placed upon a circular railway, around which it is driven by electricity. The power is applied not to the locomotive but to the *track*, in a very curious manner. Two currents of electricity, negative and positive, are applied to the rails, and by them communicate to the engine. The latter is provided with two magnets, which, by a process of alternate attraction and repulsion, drive the car over the track. A piece of lead is placed on the locomotive, making in all a weight of ten pounds, and on the application of the battery the machine moved with astonishing rapidity up a plane inclined about five degrees. Heretofore the propelling power had been used on the car itself—in this instance, however, the power is placed on the rails, and an engineer might remain in one town, and with his battery send a locomotive and train to any distance required. It would seem from the above that the idea of railway car propulsion by electricity was projected in this country more than thirty years before Mr. Siemens' motor was introduced to the public." To which we may add that, at the period mentioned, for want of a suitable electro-motor, such an invention was altogether impracticable.

Paris Cheap Messages.—On May 31, the *Daily News* had the following on the new Paris regulations:—"To-day a new tariff for the despatch of telegraphic messages comes into operation in Paris. The authorised fee had been very low, but it will be still further reduced. The French have long ago adopted a system of dual rates not quite intelligible here. The telegram may, so to speak, be sent by parcels post—that is, it may be delivered unsealed, or the recipient may have the advantage of an envelope and the privilege of opening it himself. But if he has the envelope he must pay for it, and it is on this principle that from to-day the Parisian may despatch within municipal bounds a closed message for 5d. and an open one for 3d. It is vexatious to find our own capital behind many others in telegraphic facilities. Other cities enjoy advantages which the country that originated the penny post has not extended to the inhabitants of the busiest town in the world. A message may be sent from one part of Berlin to another for fourpence, and from one part of Brussels to another for threepence halfpenny. The hardship of Londoners is the more noticeable because while other countries have advanced London has not even remained stationary, but has retrograded. A dozen years ago we had the advantage of this sixpenny telegram. Competing private companies found in cheapness an element of success. We have frequently reminded the Postal authorities of the promise made that the sixpenny telegrams should be restored when the telegraphs began to pay. Has not that time come?" We need not remind our readers that the question of cheaper telegrams has more than once been discussed in our columns, but it seems to us the time has not yet come.

The First Contriver of an Electric Telegraph.—In an article in *Social Notes* on Sir Charles Wheatstone is the following passage:—"Frequent controversies have arisen as to who should rightly be considered the first contriver of the electric telegraph for popular use. Two names have been prominently mentioned to dispute Wheatstone's claim to this distinction, namely, Steinheil of Munich and Morse of New York. It appears, according to a statement of M. Arago to the French Academy of Sciences, that the telegraph of the former was in use on the 19th of July, 1837, for a distance of seven miles, being the same month in which Wheatstone and Cooke tested their apparatus on the London and North-Western Railway. The reason, however, which gives Wheatstone a priority of claim over Steinheil beyond the fact of his patent being obtained in the preceding month, and being based upon many previously good, successful experiments, is that until August, 1838, Steinheil published no description of his means of telegraphic communication, which he altered and improved in the interval, and the only information we have of his instrument describes its improved form. His apparatus, however, was a very meritorious one, for in addition to its other excellent qualities Steinheil was the first to employ the earth to complete the circuit. But in its mechanical arrangements it was considerably inferior to Wheatstone's telegraph, and the former soon gave it up and adopted a modification of the contrivance of Morse. The celebrated dot-and-dash or registration system of this American professor, which has been generally used throughout the United States as its means of telegraphy, is said to have originated in 1832,

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and Morse claims the invention of his telegraph from this date. The first idea of such, however, was communicated to him in that year by Professor Jackson, on board the ship Sally, who was taking a voyage by this vessel with Morse from Havre to New York. When the latter had subsequently improved on his method, Professor Jackson not only emphatically declared that he had mentioned the plan to Morse, but that this American patentee upon hearing the term electro-magnetism was so ignorant as to ask, 'In what way does that differ from ordinary magnetism?' In the opinion of them both the telegraph was but a crude idea, and it was not before September, 1837, that Morse was able to publicly notify his then imperfect scheme in action, and which was nearly three months later than Wheatstone and Cooke's first telegraph patent had been sealed and the practical working of such successfully exhibited. Again, whilst this English patent was brought into daily use in a few months after it was taken out, Morse's recording instrument was not patented until 1840, and was not brought into practical use before 1844, when it first came into operation between Washington and Baltimore."

Underground Signalling.—The importance of this branch of pit work, says Mr. W. H. Routledge in a recent paper, induced him to place the following notes before the members of the British Society, an abstract of which was given in the *Engineer* from whence our note is taken. Where long planes are in use—especially when they are circuitous, and have many stations—the ordinary bell and wire signal is found very inconvenient and expensive. The following are some of the main objections to its use:—First, the loss of time; secondly, the amount of labour required; and thirdly, the inability to give an instant signal between stations in case of accident. In one case known to the writer, where an engine plane was 2,400 yards in length, and the ordinary "knocker" signal in use, it required no less than three strong lads at intervals of 800 yards to signal from the landing to the engine. And again in another plane of 1,500 yards a small capstan was required for the same purpose. Now, in each of the above cases it was impossible for a man to give a signal at any of the intermediate points in the plane; he would sometimes have to run two or three hundred yards either in or out, as the case might be, before he could signal. This means in some cases a great loss of useful effect of machinery and planes, and in several instances, if an instantaneous mode of signalling had been in operation, there is no doubt that human lives might have been saved. In one instance, mentioned by a manager in a Forest of Dean colliery, he states that the difference between the old system and the electric system enabled him to raise an extra 200 tons per day of sixteen hours; and several other cases are known to the writer where the electric signalling has been adopted in which the transit of corves has been greatly facilitated, and the cost of working reduced considerably. In giving this brief comparison the writer has not gone into any costs in the fixing and working of each apparatus, for a great deal depends on the man whose care it is under. There are a great many details in connection with the electric system which the person in charge of the plane, ropes, &c., should thoroughly understand, or else it will very soon resolve itself into a very costly and useless apparatus. The following is an example of the electric system of signalling, showing how important it is to have it well looked after, and how a nearly worthless apparatus was readily made a perfect system, and led to highly economical results. It was put down a few years ago, but not long after scarcely a day passed but that it failed for some cause or other. The electric current was produced by two groups of Leclanché batteries, of three dozen cells each, and the fluid used was a mixture consisting of seven parts of water to one of sulphuric acid; the zinc plates were in form cylindrical, and fitted round the porous cell, a small slot running throughout the whole length of the zinc; the exciting fluid was placed in the porous cell, with a mixture of blacklead and burnt cork; the connections were made by means of copper wires fastened to the cylinders of zinc, and carried from cell to cell throughout the battery. But through the apparatus being placed in unskilful hands it soon became very dirty, and the joints of the wires were imperfectly made together. In order to maintain the current the batteries had to be recharged so often that it involved a considerable unnecessary expenditure, and became a very serious item in the cost. Had there not been such a powerful exciting fluid it is questionable whether it would have worked at all. After this had been allowed to go on for some time, it was considered necessary to appoint a more competent man to take charge of the batteries and wire, so they were given into the hands of the engine planeman, who was a rather ingenious fellow; he at once changed the position of the battery, and rectified all the bad joints in the connections of the wires and earthplates, and since that time the electric signal has worked with very little trouble, the change effecting a considerable reduction in the cost of maintenance, and a marked increase in the quantity of coals hauled. There still seemed a great loss of power through imperfect insulation, so he next directed his attention to the question as to how he could use the power to the best advantage, and with the following results:—The battery was reduced in size, and placed near the bell, and the electric current was then allowed to go through the bell and along one wire to the end of the plane, and by simply drawing the wires together the current returned to the battery and the bell rang with greater force. The only means of insulation that were used were strips of leather 3in. long by 1in. wide, doubled around the wires, and nailed to the props along the road. The pit was extremely dry, which was greatly in favour of this system of insulation. The writer doubts if this kind of insulation could be adopted in a wet or damp mine, as water is a fair conductor of electricity, and if the leather insulator became at all damp a good deal of power might be lost. A good deal of trouble occasionally occurred through the wires getting entangled, or by mischievous persons tampering with them; and it was so constructed that by simply using a switch to disconnect the return wire from off the battery, and making a connection with a wire from the steam pipes, which of course have a metallic connection with the engine, drum, and main and tail ropes; now on a steel rod being placed between the wire from the battery and the hauling rope, so as to connect them, the signalling can be done as effectually as by the ordinary method; and it is worthy of remark that the force of the current seemed much stronger. This it was thought might be attributed to the greater conducting power of the 3in. circumference hauling rope, which served the purpose of a continuous earth plate. An electro-magnet was used about 500 yards along the plane from the bell, which gave a shorter and more direct path for the current back to the battery. The action is as follows:—On a signal being given from the station at the end of the plane 2,400 yards from the shaft, the "current," being in motion, attracts the armature of the electro-magnet, and makes a direct return to the battery, which saves a lot of power from being wasted. It may be said, in conclusion, that this apparatus, just briefly described, has been in use for a considerable time, and works admirably.

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REPORT.

It is rumoured that Commissioners are in England from Iceland, and that among other business to be transacted, negotiations will be opened to obtain a definite understanding as to the terms upon which Iceland might be telegraphically connected by cable with the rest of the civilised world. This is not the first time the Icelanders have opened negotiations for cable connection, but hitherto the difficulties in the way of action have proved insurmountable, and we fear no progress has been made in removing the obstacles. The question, and it seems remote of satisfactory solution, of making Iceland a station between Europe and America is to be considered, as no company could be formed for the direct connection by cable. That this should be the case hardly requires a moment's consideration. Cable work is costly, and men do not as a rule embark a large capital in philanthropy. If the powers that be in Iceland could see their way to guarantee say five per cent. per annum, they could easily obtain a cable. The commercial business, though it may be large in proportion to the population, is far from sufficient to warrant speculation in laying direct cables. We fear, then, any efforts that may be made by the Icelanders will fail to gain success, or to overcome the difficulties of the position. Efforts are not wanting in other directions to get the cable companies to go out of their way to have shorter lengths of cable and so-called midway stations.

The telephone companies both here and in America are becoming wise in their generation. It has long been foreseen that competition in this instance savours somewhat of ruination. Two or three companies cannot exist in small towns, whatever they may do in large. Smith, Brown, Jones and Robinson must all be able to converse one with another, or not at all. It will not do for Smith to be in connection with Brown and not with Jones and Robinson, Jones with Robinson and not with Smith or Brown. The value of telephone exchanges varies in ratio with the number of business or other houses with which a man can communicate. If a town has 400 houses that should be in communication, 200 of which go to one company 200 to another, the result is not a benefit, but conduces greatly to the non-use of improvement, for those using the telephone will constantly notice the inability to speak with So and So, becoming very angry, whilst entirely ignoring the benefit from being able to converse with the 199 in connection with them. Thus it is that amalgamation in some form or other is forced upon the rival interests. There are the instruments; let would-be users try them, and decide upon which they will adopt. Such is human nature, that some will have one, and some another. Besides, amalgamation will at once increase business, for many have till now held aloof, because of the difficulties gendered by antagonism, who will now join the one exchange of the town.

Prices still rule about the same. Gutta percha (genuine) is quoted at from 2s. to 3s. 6d.; reboiled, from 3d. to 1s. 9d. per lb. India rubber quotations are, per lb.: Para, fine, 3s. 8d. to 3s. 9d.; Negrohead, 2s. 11½d.; Central American, 2s. 8d. to 2s. 11d.; Assam and Pegu, 1s. 7d. to 3s.; other East Indian, 2s. 1d. to 2s. 7d.; Madagascar and Mozambique, 2s. 6½d. to 3s. Perhaps the best indication of these prices will be obtained from the following quotations:—

"India rubber quieter and lower. At auction 226 packages West India were bought in at 2s. 6d. to 3s., except seven bales scrap, which sold at 2s. 10d., 20 bales and cases pressed Guayaquil sold at 2s. to 2s. 1½d., 99 packages Madagascar bought in at 2s. 9d. to 2s. 10d., 327 bags Mozambique barely one-half sold, ball, fair to good clean 2s. 10d. to 2s. 10½d, ordinary 2s. 9½d., sausage 2s. 10d. to 2s. 10½d, one case from Ceylon bought in at 2s. 8d. per lb. Gutta percha: At auction 95 cases bought in at 1s. to 2s. 6d."

A number of interesting papers have recently appeared on electrical subjects which we hope to give in due course. Dr. Burdon Sanderson read a paper before the Royal Society on a physiological investigation, and Professor Ayrton contributed a long paper on the same evening as that communicated by Mr. Preece, given in another column. The current number of the *Phil. Mag.* contains several valuable papers.

THE CHRONOLOGY OF THE TELEGRAPH.

In his critical and laborious review of the origin and development of the electro-magnetic telegraph, with special reference to Professor Joseph Henry's contributions thereto, Mr. William B. Taylor has gone over the literature of this vast subject with great minuteness and thoroughness. We speak of the "development of the telegraph" designedly, and without reference to the world-embracing systems of telegraphic lines, for the record conclusively justifies the assertion of Robert Sabine that the electric telegraph had, properly speaking, no inventor. "It grew up little by little, each inventor adding his little to advance it toward perfection."

The more notable impulses and developments in this long evolution we *(Scientific American)* propose to summarise, following Mr. Taylor throughout.

TELEGRAPHS BY ELECTRICITY.

1774. Georges Louis Lesage, Geneva, set up the first telegraph line, which consisted of twenty-four insulated wires for the alphabet, each terminating in a pith-ball electroscope, duly lettered, for indicating by its excitation the succession of letters in the message, the transmitting operator using a manual conductor from an electrical machine.

1787. Mons. Lomond, Paris, employed a single brass wire in connection with pith-ball electroscopes, making use of an alphabet of motions.

1794. M. Reiser, Geneva, used thirty-six insulated wires for letters and numerals, in connection with a like number of narrow strips of tin foil pasted on glass; the letters and figures were cut in the foil and made visible by the passage of the electric spark.

1795. Tiberius Cavallo, England, sent explosive and other electric signals through fine insulated copper wire, using Leyden jars, and sending "sparks at different intervals according to a settled plan."

1798. D. F. Salva, Spain, worked an electric telegraph through the unprecedented distance of twenty-six miles, using a single wire, and the sparks of a Leyden jar for signals.

1816. Francis Ronalds, England, constructed an experimental telegraph line, of a single insulated wire eight miles long, operated by an electrical machine or small Leyden jar. His elementary signal was the divergence of the pith balls of a Canton's electrometer, produced by the communication of a statical charge to the wire. Lettered dials, rotated synchronously at each end of the line, served, in connection with the pith balls, to indicate the letter designated by the sender. This dial system was the precursor of Wheatstone's dial telegraph in 1839; House's letter printing telegraph in 1846; and Hughes' printing telegraph in 1855.

1828. Harrison Gray Dyar, America, constructed a telegraph on Long Island, supporting his wires by glass insulators fixed on trees and poles; the electric signals printed themselves upon litmus paper, the spacing of the marks indicating the letters and other signs. Just as Dyar and his partner Brown were seeking capital to set up a line between New York and Philadelphia a black-mailing agent, failing to extort the concession of a large share in the enterprise, obtained a writ against the two partners on a charge of conspiracy to carry a secret communication between the cities! The case was never brought to trial, but the enterprise was blocked.

According to Steinheil these various experiments put it beyond a doubt that frictional electricity might be made a successful means of telegraphic intercourse.

TELEGRAPHS BY GALVANISM.

1808. The first to apply to telegraphy the galvanic battery introduced by Volta in 1800 was Dr. Samuel Thomas Von Soemmering, of Munich. He employed the energy of a powerful voltaic pile to bring about the decomposition of water by means of thirty-five gold pins immersed in an oblong glass trough. Each of these electrodes was in connection with one of the thirty-five wires forming the line. The bubbles evolved at these electrodes were received in lettered and figured tubes, and the messages were thus spelled out. In 1810 Soemmering telegraphed through two miles of wire.

1816. Dr. John Redman Coxe, of Philadelphia, suggested a system substantially the same as Soemmering's (of which he appeared to be ignorant). He also proposed to accomplish the same result by decomposing metallic salts, as was afterwards done.

1843. Mr. Robert Smith, Scotland, devised a galvano-chemical telegraph carrying out practically the suggestion of Dr. Coxe. At first he used a separate wire for each letter, the message being printed on a strip of paper wet with a solution of ferrocyanide of potassium. Subsequently Mr. Smith reduced his line to a single circuit of two wires, and worked his system through 1,800 yards of fence wire (1846).

1846. Mr. Alexander Bain, Scotland, patented in England a

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galvano-chemical telegraph, different in mechanical details, but similar in its chemical record to the system of Smith.

1849. Professor Samuel F. B. Morse, New York, patented in this country a telegraph similar to Smith's.

TELEGRAPHS BY GALVANO-MAGNETISM.

1820. Hans Christian Oersted, Copenhagen, rediscovered the directive influence of a galvanic conductor on a magnetic needle (Romagnosi's observations of the same in 1802 having attracted no attention). The same year (1820) Professor Schweigger, of Halle, made the first real galvanometer; and shortly after Ampère, in Paris, proved experimentally the feasibility of an electro-magnetic telegraph, in which the galvanometer should take the place of the electrometer employed by Lesage.

1823. Baron Paul L. Schilling, of Cronstradt, Russia, practically applied Ampère's suggestion. In his apparatus signals were produced by five galvanometer needles, provided with independent circuits.

1824. Peter Barlow, England, experimenting with considerable lengths of wire, to test the practicability of Ampère's suggestion, was convinced that it was impracticable, owing to the rapid diminution of effect (due to increased resistance), by lengthening the conducting wire. Other inconclusive experiments in the same direction were made by Fechter in 1829, and Ritchie in 1830.

1833. Professor Carl Friedrich Gauss and Wilhelm Edward Weber constructed at Gottingen a galvanometer telegraph of a single circuit of uninsulated wire a mile and a half long. The alphabet of signs was made up of right and left deflections of the needle, observed by reflections from a small mirror. Gauss was the first to employ magneto-electricity in telegraphs. Weber added to the signalling device a delicate apparatus for setting off a clock alarm.

1836. Professor C. A. Steinheil, of Munich, undertook, at the request of Gauss, the development of the arrangement above described, and constructed a similar galvanometer telegraph line two miles in length, introducing considerable improvements. The next year Steinheil discovered that the ground might be made a part of the circuit, thus dispensing with a second wire for the return circuit.

1837. Mr. William Fothergill Cooke and Professor Charles Wheatstone patented in England a galvanometer or needle telegraph very similar to the earlier one of Schilling, employing six wires and five indicating needles. An experimental line a mile and a quarter long was worked with partial success July 25; and one thirteen miles long was established in 1838.

While these experiments with the needle were going on the electro-magnet was being developed and applied.

1820. The germ of the electro-magnet was discovered by Arago, who observed that the electric current would develop magnetic power in strips of iron and steel.

1824. William Sturgeon, England, produced the true electro-magnet with its intermittent control of an armature.

The electro-magnet of Sturgeon was improved by Professor Henry in 1828; and in 1829 he exhibited a larger magnet of the same character, tightly wound with 35 feet of silk covered wire. A pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. This was the first magnetic spool or bobbin. This invention was further improved the same year, and in 1830 Professor Henry, assisted by Dr. Philip Ten Eyck, constructed an electro-magnet which lifted 750 pounds. In 1831 he made one weighing 82½ pounds, which sustained over a ton. In the meantime Professor Henry practically worked out the differing functions of quantity and intensity magnets, and experimentally established the conditions required for magnetising iron at great distances through long conducting wires. This first made the electro-magnet available for telegraphic purposes.

1831. The transmission of signals through a mile of copper bell wire interposed in a circuit between a small Cruickshank battery and an intensity magnet—a practical telegraph—was practised by Professor Henry.

"This memorable experimental telegraphic arrangement involved three very significant and important novelties. In the first place, it was the first electro-magnetic telegraph employing an 'intensity' magnet capable of being excited at very great distances from a suitable 'intensity' battery. . . .

"In the second place, it was the first electro-magnetic telegraph employing the armature as a signalling device, or employing the *attractive* power of the intermittent magnet, as distinguished from the directive action of the galvanic circuit. That is to say, it was, strictly speaking, the first magnetic telegraph.

"In the third place, it was the first *acoustic* electro-magnetic telegraph."

Further on Mr. Taylor pertinently remarks that it is suggestive to consider how different would have been the popular estimate of Professor Henry's labours if he had been worldly-wise enough to secure an early patent on these three indisputably original and most pregnant features of telegraphy.

1837. Professor Samuel F. B. Morse devised a magneto-electric telegraph capable of transmitting signals through a circuit of forty feet, but failed for longer distances from the circumstance that he used a quantity current. His friend, Dr. Gale, made for him an intensity battery, and added a hundred or more turns to the coil of wire around the poles of the magnet. With these necessary (and radical) improvements the apparatus was made to work through ten miles of wire. In applying for a caveat for his invention, October 6, 1837, Professor Morse specified six distinct parts, not one of which enters into the established "Morse" telegraph of to-day. Mr. Taylor shows that Professor Morse's real contribution to telegraphy consists first in the adaptation of the armature of a Henry electro-magnet to the purpose of a recording instrument; and, second, in connection therewith, the improvement on the Gauss and Steinheil dual-sign alphabets, made by employing the single line dot and dash alphabet.

In his general summary of the history of the origin and development of the electro-magnetic telegraph, Mr. Taylor sets down the leading preparatory investigations and discoveries as these five:—

1. The discovery of galvanic electricity by Galvani, 1786-1790.
2. The galvanic or voltaic battery by Volta, 1800.
3. The directive influence of the galvanic current on a magnetic needle by Romagnosi, 1802, and by Oersted, 1820.
4. The galvanometer by Schweigger, 1820 (the parent of the needle system).
5. The electro-magnet by Arago and Sturgeon, 1820-1825 (the parent of the magnet system).

The second half dozen capital steps in the evolution of telegraphy were:—

1. Henry's most vital discovery, in 1829 and 1830, of the intensity magnet and its intimate relation to the intensity battery.
2. Gauss' improvement, in 1833 (or probably Schilling's, considerably earlier) of reducing the electric conductors to a single circuit by the ingenious application of a dual sign, so combined as to produce a true alphabet. (The anticipations of this idea by Lomond in 1787, Cavallo in 1795, and Dyar in 1825, are not regarded as practically influential in the progress of telegraphy).
3. Weber's discovery, in 1833, that the conducting wires of an electric telegraph could be carried through the air without insulation except at the points of support.
4. As a valuable adjunct to telegraphy, Daniell's invention of a constant galvanic battery in 1836.
5. Steinheil's discovery, in 1837, that a single conducting wire is sufficient for telegraphic purposes.
6. Morse's adaptation of the armature of a Henry electro-magnet as a recording instrument, 1837, and the single line dot and dash alphabet in 1838.

The earlier needle type of electro-magnetic telegraph has found its special application in ocean lines, no element of the Morse system entering into the operation of submarine cables.

The more recent telegraphic developments do not fall within the scope of Mr. Taylor's review. A few other dates as given by Prescott may appropriately serve to complete this chronology.

1861. Reiss discovered that a vibrating diaphragm could be actuated by the voice so as to cause the pitch and rhythm of of vocal sounds to be transmitted to a distance and reproduced by electro-magnetism.

1872. Stearns perfected a duplex system whereby two communications could be simultaneously transmitted over one wire.

1874. Edison's quadruplex system was invented.

1874. Gray invented a method of electrical transmission, by means of which the intensity of tones as well as their pitch and rhythm could be reproduced at a distance; and subsequently conceived the idea of controlling the formation of electric waves by means of the vibrations of a diaphragm capable of responding to all the tones of the human voice.

1876. Telephone invented. Bell invented an improvement in the apparatus for the transmission and reproduction of articulate speech, in which magneto-electric currents were superposed upon a voltaic circuit, and actuated an iron diaphragm attached to a soft iron magnet. During the same year Dolbear conceived the idea of using permanent magnets in place of the electro-magnets and battery previously employed, and of using the same instrument for both sending and receiving.

1877. Edison's carbon telephone was brought out.

To these may be added Edison's electro-motograph, of electro-chemical telephone, 1877.

1878. Duplexing of ocean telegraph[1]

1879. Cowper's writing telegraph.

1880. Field's successful substitution of dynamo-electricity for galvanic batteries in telegraphing.

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CARBONS AND DIFFUSION APPARATUS FOR THE ELECTRIC LIGHT.

Much has been done within the last few years to improve the quality of the carbon available for the production of the electric light; and a vast amount of endeavour, in many different directions, is at the present moment being expended in the manufacture of this material. It may be said also that the old objection made in the statement that the dazzling powers of the light were more than equal to its illuminating efficiency has been obviated by a more or less judicious use of reflectors and of opalescent and frosted glass globes. Nevertheless, it would appear to be the decided opinion of the majority of those who are engaged in the practical introduction of the electric light that carbons of greater purity and homogeneousness, and a more perfect mode of distributing the illumination, still constitute the main *desiderata* in this application. The inventors of new forms of regulator lamps are unanimous in the opinion that the inconvenient variations in the intensity of the light are due not so much, if at all, to any imperfection in their mechanical arrangements as to defects in the carbons; and, whilst it is admitted that the light is softened and enhanced in beauty by the use of glass globes, it is not unreasonably contended that the improvement is somewhat analogous to "placing one's light under a bushel," and that a percentage of from 30 to 60 per cent. of the intrinsic illuminating power is a heavy price to pay for the diffusion of the remainder.

We should be glad to have the whole question as to the production of carbons for the electric light discussed in our columns; and we think it might be to the advantage of those who are investigating the conditions of this manufacture if they took an occasional opportunity of comparing notes. In the meantime we may state some considerations which occur to ourselves. In the first place we would point out that, if the production of pure carbon be considered a point of importance, the use of materials, such as coke or wood-charcoal, containing earthy and siliceous impurity, should be scrupulously avoided. Even gas-retort carbon—although it may be difficult to account for its contamination, deposited as it is from the heavier carbide of hydrogen by the effect of a high temperature—should, as experience has proved, be rejected, if a product of great purity is aimed at. There is, indeed, no difficulty in obtaining carbon perfectly free from solid impurity; and, so far as we can perceive, such a material may even be obtained at moderate cost. Crystallised sugar—sugar candy, even when highly coloured, may be considered as being a compound of carbon and water only; and, if the water be expelled from it, pure carbon, of course, remains. Such a carbon has the advantage over lamp black—which also is free from solid impurity—of being much more dense, and of containing no hydro-carbons or other volatile matter which would tend to diminish the density of the manufactured product. M. Jaquelin, the chemist, of *l'Ecole Centrale* at Paris, has produced a very dense carbon, almost if not quite equal in purity to that obtained from crystallised sugar, by imitating the conditions which prevail inside of the gas retorts during the manufacture of gas. It is stated that this carbon gave a perfectly steady light that was not only whiter but considerably more intense than that obtained with the same current when carbons prepared in the ordinary manner were employed. It seems, however, to be now generally admitted that the process adopted by M. Jaquelin is not, from a commercial point of view, adapted to the requirements of practice. We must not, in this connection, forget to mention the name of M. Gaudoin, who has obtained a carbon of very fair purity by decomposing bitumenous, resinous and fatty matter in closed retorts of plumbago maintained at a bright red heat. The Gaudoin carbons are tolerably well known and appreciated in this country; and the results of the careful trial of them by M. Fontaine are summed up in the statement that "there is neither disaggregation nor sparks, and less cinders than with the Carré and Archereau carbons."

Judging from the results obtained by some experimenters, their notion of what constitutes a pure carbon is certainly not in advance of that entertained by Messrs. Greener and Staite, who, in 1846, took out the first patent for carbons to be used in electric illumination. "Pure carbon," they state, "is obtained by the following process:—Lamp black, or (by preference) Church's purified coke, is digested in dilute nitro-muriatic or other acid, strained, washed in a weak alkaline solution, and washed in distilled water until no traces of impurity are perceptible; it is then dried, and by pressure converted into solid prisms, or into cylinders both solid and hollow; it may then be subjected to intense heat for twenty-four hours." The purification of coke by Church's process, as will be seen from the following specification of it, may be qualified as "a delusion and a snare." Mr. Jabez Church, whose patent dates from 1845, states that "If it be desired to obtain a coke more than usually free from sulphur, &c.; as soon as the apertures admitting air to the coke are closed, a current of electricity from a powerful electric battery is transmitted through it by means of iron rods inserted through the brickwork, and connected with the poles of the battery, the positive pole being near the bottom, and the negative pole lying on the top of the coke." Equally a delusion is it to suppose that the detrimental impurities in coke can be removed by alternate treatment with dilute acid and weak alkaline solutions.

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We are by no means positive, however, that absolute chemical purity, or even freedom from sensible admixture, is an essential condition in carbons for the production of the voltaic arc. The impurities, or substances in admixture, may in some cases be actually of advantage, and in other cases may be made to counteract each other. Thus M. Carré says that potash and soda at least double the length of the arc, rendering it also free from the hissing sound produced when a purer carbon is used; whilst, by combining with the silicates that are usually present, they eliminate these substances from the pencil points, causing them to fuse into clear, vitreous and often colourless globules just outside the arc. The same authority states that the presence of either of these alkalies increases the illuminating power in the ratio of 1·23 to 1. Boracic acid, he found, materially increased the durability of the carbon by fusing on its surface, and thus protecting it from the atmospheric oxygen. Still, in regard to the question as to the necessity for using a pure carbon, it may at least be said that the substances in admixture as well as the percentage of them, should be of our own selection.

But even greater importance, we think, is to be attached to the question of obtaining carbons, not only of the requisite degree of density, but perfectly amorphous and homogeneous throughout their substance. Nor is this desideratum so easy of attainment as that of almost absolute chemical purity. The latter, it is to be observed, may—though we cannot say it ordinarily does—exist in conjunction with flaws and other irregularities of structure, which give rise to the splintering, disaggregation and sparking that contribute so much to the irregularity of the light, and are so frequently to be observed when the arc is examined through the protecting medium of cobalt-tinted glass. In our view, most of the less pure varieties of carbon, if of uniform "texture," would practically give a better result than a carbon of great purity but mechanically defective.

In regard to apparatus for distributing or diffusing the light, we think that the "sun-burner" arrangement adopted by Dr. Siemens at the Albert Hall and elsewhere, in conjunction with a gilt reflector, leaves little to be desired when a combination of powerful lights can be placed at a considerable altitude in an enclosed space. But the use, under other conditions, of a naked light is out of the question; and, from an economic point of view, the employment of an opalescent glass sacrificing more than half, or even of a frosted glass cutting off more than one-fourth of the available light, cannot be regarded as an expedient to be permanently adopted. We look forward, therefore, with some interest to some experimental trials which, we hear, are shortly to be made on a system of diffusion, the efficacy of which is due to the peculiar properties of platinised glass. This material, especially as prepared by a new process, has, in virtue of its reflecting power, the appearance of a perfect mirror when viewed by reflected light; whilst, if viewed by transmitted light, it appears as a medium of imperfect transparency, shading, or reducing the dazzling effect of, the luminous focus. It is proposed by the use of lamp-glasses of the material in question to utilise by reflection the greater portion of the light which is not transmitted, and which by the ordinary method of shading is entirely lost. To distribute this portion of the light horizontally, or nearly so, some of the luminous rays would obviously require to be twice reflected; but, though we cannot say with certainty what would be the percentage of loss due to this double reflection, it appears certain that a considerable economy of illuminating power may be obtained by the use of this device in lieu of the ordinary means adopted for shading the light.

THE ELECTRIC LIGHT IN THE CITY.

It is often remarked that one of the wonders of "the City" is in its teeming population during the day, busy and noisy, contrasted with its emptiness during the night hours. With the morning hours the busy human tide wells in from every point of the compass, to leave its labours in the gloaming. One of the most amusing investigations is to find out how this multitude is fed day by day. The *habitué* of the "City" will take you into courts and corners, pointing out here and there some celebrated house where a "chop," or "coffee," or "dinner," can be obtained. Still, for a long time, the cry has been, Where shall we lunch? Where can we get decent food, at a fair price? Where can we get from the rush and the crowd to eat a light meal in peace and comfort? The Coffee Palace Company has endeavoured to supply this want in adapting the vaults of the Royal Exchange to the purposes of a restaurant. The great difficulty to contend against in the course of this adaptation has been that of ventilation. It is absolutely necessary to have artificial lights burning for many hours, and the heating and vitiation of the atmosphere by gas jets seemed a superlative obstacle to the formation of comfortable rooms. Fortunately, by using the electric light, one source of annoyance could be avoided.

The British Electric Light Company was invited to arrange for the lighting electrically. This company has been very successful in its operations, as St. Enoch's Station at Glasgow and the Picton Reading Room at Liverpool testify. It has no particular lamp of its own, nor any particular hobby to satisfy, hence it uses whatever is most suitable for the work in hand. The machine to generate the electric current adopted by the company is that of Gramme, than which a better may not as yet be found.

In the lighting of the Coffee Palace beneath the Exchange it was decided to use the André lamp, not the one recently described in our columns, with Mr. Brougham's water-tight joint, but the lamp alone. Thirty of these lamps are used. They are on the incandescent principle, a carbon rod of small diameter, touching a copper wedge, the former falling as consumed by its own weight, assisted by that of a small weight on the top of the rod. The lamp burns for nine or ten hours without requiring fresh carbons.

The engine used to drive the Gramme machine is a 12 H.-P. Otto silent gas engine, working up to 18 H.-P., or even higher if required. Whilst we were present the lamps burned with a fairly steady light.

The Coffee Public Houses National Society has aided the electric light by the manner adopted in colouring the walls and columns. White, or an approach to white—blueish white—is the colour applied to the column, and this, of course, instead of absorbing, assists in diffusing and giving uniformity to the light. We appreciate much more the introduction of the electric light to what may be termed actual service than when it is merely put forward as a temporary or experimental device. The British Electric Light Company has not posed before us in experimental work. What has been done has been done for permanent service, and it is to be hoped the success which has hitherto attended their efforts will continue to follow them. Much, no doubt, is due to Mr. Ward, their engineer, and to his care taken to have the work done in the best possible manner.

SOCIETY OF TELEGRAPH ENGINEERS.

MAY 26.

A DECADE IN THE HISTORY OF ENGLISH TELEGRAPHY.

BY E. GRAVES, ESQ.

(CONCLUDED FROM PAGE 22.)

As an auxiliary to telegraphs a special agent was employed in 1869, and to a far larger extent in 1879, being a sort of local supplement to wires and instruments. Pneumatic tubes are calculated much more satisfactorily to carry a large number of messages a short distance than are wires, but it was only the Electric Telegraph Company that in the earlier periods availed itself of their use. That company possessed 2 miles 325 yards of pneumatic tubes in 1869, besides 1,472 yards in various provincial towns.

In 1879 there were in existence 21 miles 200 yards of pneumatic tubing in London, some of it of much greater diameter than that used by the Electric Company; and, in addition, pneumatic systems of greater or less extent, in the whole amounting to 6 miles 800 yards, in Liverpool, Manchester, Glasgow, Dublin, Birmingham, and Newcastle-on-Tyne.

In 1869 the number of towns supplied with intelligence by electric telegraph in this country was 144, and in them news was furnished to 173 newspapers and 133 other subscribers. In 1879 the number had increased to 313 towns, 518 newspapers, and 288

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institutions or individuals supplied. And the number of words transmitted—which in the days of the telegraph companies was a varying daily average of from 4,000 in the non-Parliamentary season to 6,000 when the Houses were sitting—has grown until, in 1879, it reached 24,000 and 37,000 words in the corresponding seasons. This news is despatched by the two great Press agencies to the towns enumerated previously, the actual words transmitted over the wires to the various places often exceeding half a million, the same words having to be repeated to many places. Besides this, from 30,000 to 70,000 words per diem, according to the season, are despatched as special reports for various London and provincial newspapers, from their own correspondents, being wholly additional to the general news supply. There are certain newspapers to whose use special wires are devoted, *i.e.*, instead of receiving intelligence transmitted over the ordinary wires in the ordinary way, they have arranged to have certain wires given up for their sole use from 6 p.m. to 6 a.m., or other hour, and send over them whatever matter they like without its being counted as business done by the Post Office, clerks being lent to them for the purpose. The Electric Telegraph Company, prior to the transfer, had inaugurated this system. In 1869 there were a total of six special renters, each paying from £750 to £1,000 per annum for the wire appropriated to them. In 1879 there were 24 such renters, each paying £500.

It may be of interest to observe that in 1869 the working of the various telegraph undertakings, other than those of railway companies, employed a total force of 2,514 clerks, 479 of whom were females, and 1,471 messengers. In 1879 the clerks numbered 5,611, of whom 1,556 were females, and 4,648 messengers.

Comparisons are often made between the development of the postal service and that of the telegraphic service. In such comparisons there are various elements of vital difference that are often wholly overlooked, but yet the absolute results may be fairly stated. For the financial year ending 31st March, 1873, the number of telegrams forwarded throughout the United Kingdom was 15,535,000; it was for the year ending 31st March, 1880, over 26,500,000, being an addition of nearly three-fourths in seven years.

Next to England, in order of telegraphic importance among the countries of Europe, come France and Germany. There has not yet been time to obtain the foreign statistics for the year 1879, and therefore I will use those of 1878, contrasting them, of course, with the English figures for the same year. In that year the population of Great Britain and Ireland was reckoned at 33,799,000, and this population exchanged a total of 24,600,000 messages. In France the population of 36,900,000 (an excess of more than 3,000,000 over that of Great Britain) employed the telegraph to the number of 14,400,000 messages, or upwards of 10,000,000 less than the number passed over the wires of this country. Germany contrasts even more unfavourably. With a population of 42,700,000, the number of telegraphic despatches was barely 100,000 more than those of France, or 14,540,000. The only cases in which the proportionate number of messages is at all larger than in Great Britain are those of Belgium and Switzerland. In neither of these States does the total number of messages amount to 1 per head of the population, and in Belgium the number forwarded is even closer to the British ratio as compared with population. But both these countries derive an exceptional advantage from the number of foreign telegrams passing through them, and not, as it were, resting within their borders. English messages are not swollen to any appreciable extent from this cause. Switzerland, moreover, has its native business largely increased by the host of locomotive and telegraphing foreigners annually attracted to the playground of Europe. Hence I think it may be fairly said that England is decidedly ahead of continental Europe in the matter of telegraphic employment. During the present year arrangements have been made for the erection of over 5,000 miles of new wire, intended to meet the demands upon the system made by the prospect of reviving trade. The cost will not add to capital sunk in telegraphs, but will be all charged to the revenue of the department.

RAILWAY TELEGRAPHY.

I now enter upon the second branch of my subject, and fortunately I can deal with it somewhat briefly. It does not ramify into so many branches as does commercial telegraphy; and the great progress it has made is more strikingly expressed by the statistical table than by anything that can be described in mere words.

In 1869 the "block" system, although it was a thriving child, was comparatively in its infancy, and the adoption of telegraphy to any large extent, as a means of indicating the correct operation or otherwise of distant fixed signals, was confined to a very few companies.

As is well known, the block system resulted from the experience gradually obtained by railway companies as to the impossibility of avoiding collisions so long as they relied upon an interval of time only to separate their trains. It was found that an interval of distance must be provided; and it is to the electric telegraph that they owe the possibility of doing this.

On any length of railway it is only necessary to divide the line into short sections, and to control each of them by an electric telegraph, on the simple principle that a train should not be allowed to enter on any one of the sections until the train preceding it had been signalled from the further end thereof as having completed its run to that point.

After the soundness of the principle had been proved by the test of actual use, it was gradually adopted on some of the most important lines; and I find, for example, that the London and North Western Railway Company had, in 1869, 511 block instruments (*i.e.*, instruments a combination of signal-needle and bell) used for thus dividing the railway.

But in 1879 it will be seen that the number of instruments of similar character had grown to upwards of 3,000. To a considerable degree this great increase (sixfold) arose from the extension of the block system to new branches or lines of railway, but it is also to a great extent due to the subdivision of the sections originally arranged; as, for example, would be the case when a line originally divided into lengths averaging two miles each was divided into lengths of one mile.

Signal repeaters also show a very marked increase on almost all railways. Their use is to notify to the man putting on a distant signal that the semaphore arm really points in the manner intended by him, or that, when signal lamps have been lighted some distance away from the station, they are burning properly, and indicating that which they are intended to do. Should the semaphore arm move from the position in which it has been placed by the levers, an indicator in the signalman's box whence the levers are worked will immediately point and show that something has happened, or a bell will ring. In the same way, another indicator arranged in an electric circuit, to show when a lamp is burning steadily, will shift its position and alter its direction if the lamp goes out.

The utility of these arrangements, as securing the continuity of perfect signals, is self-evident, as in many instances both semaphores and signal lamps are only imperfectly, if at all, visible from the stations or junctions they are intended to protect.

It will be seen that almost all important railways have very much enlarged their employment of this useful branch of electric agency. The North Western Company, for example, have increased its employment from ten to 1,715 signal indicators, and the Great Western from 410 to 1,865.

I have to express my thanks to the managers, engineers, telegraph superintendents, and other officers of the various railway companies to whom I am indebted for the table of statistics relative to railway telegraphs that I have been enabled to compile.

On the whole there were 62,100 miles of wire devoted to railway use, with 13,128 speaking instruments, and 33,719 block and other distinct signals of all kinds, on the 31st December, 1879.

To this extent is the telegraph an auxiliary to railway service.

Viewing the progress made in the development of English telegraphy as a whole during the past ten years, we who have taken part therein, however humble, may well be proud of it. In every field and every branch a great onward stride has been made. Let us trust that the next ten years will show as satisfactory a record. Our motto must ever be "Onward." The attainments of the past are but an earnest of what the future should and will achieve.

ON SOME THERMAL EFFECTS OF ELECTRIC CURRENTS.*

BY W. H. PREECE, ESQ.

I have been engaged for some time past in experimenting on the thermal effects of electric currents, but the final results of those experiments are not sufficiently ripe at present to justify my bringing them before the Royal Society. I have, however, obtained one result which I believe to be sufficiently novel to justify a short preliminary note.

The most striking facts elicited by these experiments are:—

1. The extreme rapidity with which thin wires acquire and lose their increased temperature.

2. The excessive sensibility to linear expansion which fine wires of high resistance evince.

Now, as the rate of heating, and therefore of expansion and

* Abstract of a Paper read before the Royal Society, May 27, 1880. Corrected by the Author.

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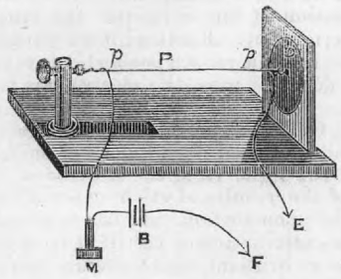
contraction, varies very nearly directly as the increment or decrement of the currents, when these variations are very small, it occurred to me that if a long wire of small diameter and high resistance were attached to a sounding board, or to the centre of a disc (such as one of those used for telephones and phonographs), and it formed part of a circuit conveying telephonic currents, sonorous vibrations ought to be reproduced.

The sketch shows the arrangement of the apparatus used for the experiment.



A was a stout base of mahogany, on which a brass support, C, was attached so that it could slide and be fixed at any distance from D.

D was at first a disc of thin paper, and then of thin iron.

P was the wire experimented upon whose loose ends were connected to terminals on the wooden base, so as to be inserted in the circuit containing a microphone transmitter, M, and a battery, B, of six bichromate of potash cells in another room out of hearing.

A platinum wire of 0·003 inch diameter and six inches long from p to p' was first used, and the sonorous effects were most marked and encouraging when the microphone transmitter M was spoken into. The articulation, though muffled, was clear, and words could easily be heard.

1. Experiments were first made to determine the length which gave the loudest sound and the clearest articulation, and, after repeated trials with every variation of length from one inch to six feet, it was found that a wire six inches long gave the maximum effect.

2. Experiments were then made to determine the diameter of the wire that gave the best effect, and after repeated trials with every gauge drawn from 0·0005 inch to 0·005 inch it was found that wire of the diameter 0·001 inch gave the best effect.

3. Experiments were then tried with wires six inches in length and 0·001 inch diameter, of different materials, viz., gold, iron, aluminium, silver, copper, palladium, and platinum, and they came out in the following order of merit :—

Platinum	Very clear.
Aluminum	Very variable.
Palladium	Clear.
Iron	Clear.
Copper	Faint.
Silver	Faint.
Gold	Very poor.

4. The effect of mechanical strain was tried. It was found not to vary the effect. When once the requisite tension, which varied with each metal, was obtained, further tightening up did not vary the clearness or loudness of articulation.

Gold would scarcely bear the tension required to reproduce sonorous vibrations, hence its low position.

5. Very thin carbon pencil, ·0625 inch diameter, was tried under compression and under tension, but no effect whatever was experienced unless a bad joint was made, when at once a faint microphonic effect was apparent.

6. No sibilant sounds whatever could be reproduced.

7. That the effect was due to heating and cooling was shown by the fact that it was possible to increase the current to such a strength as to render the temperature of the wire sensible to the touch, and then to make its elongation and contraction by low sounds evident to the eye.

It therefore appears from these experiments that wires conveying those currents of electricity which are required for telephonic purposes expand and contract as they are heated and cooled, and as the variations in the strength of the current are small compared with the strength of the current itself, the expansion and contraction vary in the same ratio as the condensation and rarefaction of the air particles conveying the sonorous vibrations which produced these vibrations.

The mechanical changes, or molecular vibrations, in the wire, due directly or indirectly to telephonic currents, which result in the reproduction of sound, bear a close analogy to the mechanical changes due to the direct transmission of sound, but with this important difference, that while the vibrations due to sound are progressive along the wire, and their velocity is low and easily measured, those due to thermal effects are practically instantaneous, and therefore affect simultaneously the whole length of the wire.

Note.—De la Rive, in 1843 (*vide* "Electricity," vol. i., p. 304), observed that an iron wire emitted sounds when rapid discontinuous currents were passed through it, but he attributed the effect to magnetism, for he failed to obtain the same effect in non-magnetic wires like platinum or silver.

Graham Bell found, in 1874, that a simple helix without an iron core emitted sounds, and (in 1876) that very distinct sounds proceed from straight pieces of iron, steel, retort carbon, and plumbago when conveying currents.

Professor Hughes showed that his microphone was reversible, that is, that it could receive as well as transmit sonorous vibrations.

Mr. Weisendanger (*Telegraphic Journal*, Oct. 1, 1878) reproduced sounds on a microphonic receiver, which he called a thermophone, and attributed the effect to its true cause, viz., the expansion of bodies under the influence of heat, which, in fact, is the explanation of all microphone receivers.

Ader reproduced speech by the vibrations of a wire conveying currents of electricity, but he found that only magnetic metals were effective, and therefore, like De la Rive, he attributed the result to magnetic agencies. (*Vide* Count du Moncel, *Telegraphic Journal*, March 1, 1879).

These and many other sonorous effects of currents on wires may be really due to such heat effects as I have described.

THE MARCEL DEPREZ GALVANOMETER.

BY M. A. NIAUDET.

(Translated from *La Nature*.)

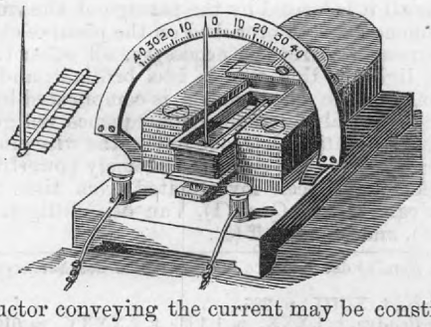
M. Marcel Deprez recently laid before the *Société de Physigue* a new galvanometer* which will frequently be of service to those who employ powerful currents. The learned physicist has aimed at making the needle very light, whilst at the same time subjecting it to a very powerful magnetic directive force.

The figure represents one of the forms which have been given to the instrument.

Here the needle is multiple ; being in fact composed of sixteen or eighteen parallel needles mounted on the same axis. The appearance of this needle (shown to the *left* of the figure) has caused the instrument to be termed the *fish-bone galvanometer*. The needle in question is made of soft iron ; and, as may be seen, is placed between the two arms of a horse-shoe magnet. This magnet, which is of great power, magnetises the needle by induction and directs it strongly in its own plane—so strongly that, if the system of needles be deflected from this plane, it returns to its position of rest with a sudden jerk, and oscillates within very short limits. The conductor for the current which is to act upon the needle is wound upon a small rectangular frame between the needles and the arms of the magnet.

The moment a current passes, the needle suddenly jumps to its new position of equilibrium and maintains itself there, without performing those long oscillations which, with ordinary galvanometers, cause experimenters to lose so much time.

The instrument is completed, as the figure renders it almost unnecessary to explain, by a pointer moving in front of a graduated scale. In the apparatus as here represented, the axis which carries the needles is in the horizontal plane of the directing magnet. In another form of the instrument this axis is perpendicular to the general direction of this magnet, the needle is single and moves in a vertical plane ; and in this arrangement, the scale being placed against the magnet, a saving of space is effected. We have preferred to represent what is termed the fish-bone arrangement, as it is the easiest to elucidate by means of a drawing.



The conductor conveying the current may be constituted of a

* The instrument cannot correctly be termed a *galvanometer* ; it is merely a *galvanoscope* or *indicator*.—Ed. *E.*

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number of turns of silk-covered wire, as in the figure, or by a single strip of copper, so as to render the resistance almost nil.

It will be seen that this galvanometer does not require to be arranged with the needles in the magnetic meridian, since in the position they occupy they are under the influence of a directive force infinitely greater than that of the earth.

But the most important property of this instrument is that of giving almost instantaneously an indication of the intensity of the current; from this it follows that very sudden and brief variations of intensity, such as would not be shown on any of the present galvanometers, may be detected. This property, as we have already intimated, is due to the extreme lightness of the movable system, and to the powerful attractions to which it is subjected. When the needle makes a considerable deflection in starting to a position of equilibrium under the joint influences of the magnet and of the current, it oscillates it is true for a moment; but these oscillations resemble the vibrations of a tuning-fork, and indicate the intensity of the forces in action. If the instrument be placed in the circuit of a Gramme machine, the needle exhibits by its vibrations every irregularity in the motion of this apparatus. If the current from a powerful battery be passed through the coils of a large electro-magnet, and studied by means of this galvanometer, the intensity of the current may be seen to vary and to increase during a considerable period of time, which under special conditions may extend to a minute; that is to say the production of the magnetic effect is not completed until the end of this period, during the whole of which the inductive reaction of the electro-magnet is appreciable and continuously decreasing. This remarkable phenomena, discovered, so to speak, *en passant*, by M. Marcel Deprez, shows what services may be rendered by the instrument we have described.

It may further be pointed out that the galvanometer in question allows of a mechanical measurement of the intensity of a current, in which this may be said to be *weighed*. If, for instance, we can produce a given deflection of the needle by means of a weight of 10 grammes acting on a radius of 10 centimetres, it may be said that a current producing the same deflection produces an effect equal to that of the weight. It is scarcely necessary to say that intense currents may be obtained, not only from powerful sources, but also from those that are weak, provided the resistance of the latter is inconsiderable.

ON THE LUMINOSITY OF ELECTRODES.

Not long ago Professor Guthrie exhibited a striking experiment before the Physical Society of London, which was described in our columns. This consisted in showing that platinum electrodes immersed in dilute sulphuric acid became intensely luminous when the current of a battery of ten Grove cells was passed through them. The luminosity appeared to be due to heat developed by the passage of the current across the cushion of gas surrounding the wires. The recent researches of M. R. Colley, Professor of Physics of the University of Kasan, published in the *Journal of the Physico-Chemical Society of St. Petersburg*, are of interest in connection with this subject.

Professor Colley describes the phenomenon in question in the following terms:—When using an intense current in the electrolysis of acidulated water, if one of the electrodes, particularly the negative, present a small surface, say that of a platinum wire plunged in the liquid to a short depth, the electrolysis of the acidulated water, at first tumultuous, suddenly ceases at a certain moment, or at least becomes almost insensible. At the same time we observe the negative electrode to glow all over with a blueish light, flashing, and accompanied by a peculiar hissing, sputtering, noise. An elevation of the temperature of the liquid greatly favours the appearance of the phenomenon. The elevation may be caused either by heating the liquid with a lamp, or waiting until it is heated by the passage of the current. The same phenomenon can be provoked on the positive electrode, but for that a stronger current is necessary, all other things being equal. The light in this case is less brilliant, and presents a reddish tint, and the phenomenon is complicated by the incandescence of the metal electrode, a consequence not generally observed with the negative electrode unless the wire plunged in the liquid is very fine, and the current extremely powerful.

These effects have been investigated from time to time by Mackrell, Neare, Grove, Quet (1), Van der Willigen (2), Planté (3), Righi (4), and Slouginoff (5).

1. *Comptes Rendus des Scéance de l'Academe des Sciences*, t. XXXVI., p. 1,130.
2. *Pogg. Ann.*, t. XCIII., p. 285.
3. *Comptes Rendus*, t. LXXX., p. 1,133; t. LXXXV., p. 619.
4. *Il Nuovo Cimento*, 3° Série, t. I., p. 267; 1877.
5. *Journal de la Société-physico-Chimique de Saint Petersbourg*, t. X., p. 241.

Righi succeeded in producing the phenomenon under conditions somewhat different from those of other experimenters. He plunged into a vessel containing acidulated water a second vase filled with the same liquid, and furnished with a small and very narrow slit or aperture; and when the vessels communicated with the poles of a strong battery, there could be seen in the interior of the rift a light similar to that which is produced upon the electrodes.

To Slouginoff we owe the important observation that whilst there is illumination of the electrodes the current is not continuous, but intermittent. Further, if we suppose that the time during which the current passes is short compared with the time during which it does not pass, the electrolysis is almost entirely stopped.

The aim of M. Colley in prosecuting his researches was (1) to determine the cause of the intermissions of current; (2) to study the spectrum of the light from the electrodes; (3) to give, with the assistance of the results of other experimenters, a plausible explanation of the phenomenon. He has confined himself almost exclusively to an examination of the light from the negative electrode, which is more brilliant, and therefore more easily observed than that from the positive electrode.

To elucidate the first question he scrutinised the light of the negative electrode by means of a rotating mirror making from twelve to fifteen revolutions per second. The phenomenon presented the following aspect:—Upon a background feebly illuminated could be seen a multitude of brilliant stars of light, appearing for an instant then disappearing, and distributed without any regularity. At a given instant the aspect of the phenomenon resembled that of the heavens on a clear starry night, and was only to be distinguished from it by the constant shifting of the mimic stars. It is evident that this appearance can only be presented when the light is formed by isolated sparks bursting successively from different points of the electrode. It is easy to understand that if the current be intermittent and the time of its passage small compared with the time of its cessation, the multiplicity of sparks will not make up for their brief individual existence.

The spectrum of the negative electrode is composed of bright lines. In employing diluted sulphuric acid and an electrode of platinum, we see at first the red line and the blue line of hydrogen, the red line being extremely vivid. With solutions of chloride of sodium or chloride of lithium, we observe besides the hydrogen lines the lines characteristic of these metals, and when the current is sufficiently energetic, not only the red line, but also the orange line of lithium can be seen. In the middle part of the spectrum also, and chiefly in the green section, is apparent several bright lines, some of which are beyond question the lines of platinum. Their appearance might have been foreseen, for experiment shows that the electrode is, little by little, disintegrated by the passage of the discharges, and the liquid is rendered turbid by the presence of a very fine black powder, which cannot be anything else than platinum dust.

The following table contains the wave lengths, in millionths of a millimetre, of the most brilliant lines found in the middle part of the spectrum. The letters *tf*, *f*, and *m* designate very strong lines. In the third column are given the wave lengths of some lines of platinum determined by M. Lecoq de Boisbaudran, which are probably identical with those of M. Colley:—

Lines.	λ (Wave-length) M. Colley.	λ M. Lecoq de Boisbaudran.
1 *m*	505·4	505·9
2 *tf*	510·2	,,
3 *f*	515·4	,,
4 *tf*	522·3	522·8
5 *f*	530·6	530·2
6 *m*	539·5	539·4
7 *f*(2)	548·0	547·6
8 *tf*	565·0	,,

From these figures we see that besides the platinum lines to the number of five there are others of which the origin is as yet unknown. It is possible they may be due to impurities in the platinum of commerce.

On substituting an electrode of silver for the platinum one the appearance of the spectrum was completely changed; the platinum lines disappeared, and there could be seen instead the two apple green rays characteristic of silver.

The preceding results would seem to prove conclusively that the spectrum of the negative electrode is of a mixed character, depending both on the nature of the liquid and the electrode. The current employed by M. Colley in his researches was produced by a Bunsen battery of 96 elements freshly charged.

(1) "Spectres lumineux," p. 182, Paris, Ganthier-Villars, 1874.
(2) Double line.

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With a more feeble current, the phenomena presented a much less brilliant splendour.

It would have been interesting if Professor Colley had been able to tell us how the spectrum of the light seen in the aperture of the inner vessel by M. Righi is composed; but he did not succeed in obtaining a sufficiently bright light of this kind to fix the position of the lines in the spectrum.

What, now, is the most probable explanation of the luminosity of the electrodes? The experiments with the rotating mirror proves that it is a matter of spark discharges across an insulating coating or cushion surrounding the electrode, and separating it from the liquid in which it is immersed. It only remains, therefore, to explain the formation of such an insulating cushion of gas.

Some physicists have suggested that the electrode is heated to a considerable degree during the progress of the phenomenon, and that the liquid which encircles it assumes the spheroidal state, and remains separated from it by a cushion of vapour. It may happen sometimes, in fact, in employing a very energetic current, that the electrode becomes incandescent, and the liquid ceases to wet it. Such a state might last for several seconds after interruption of the current; but it is merely an accidental effect. An experiment made by M. Colley, if it does not decide the true nature of the insulating couch, at least proves that the illumination can be produced upon an electrode quite cold. He took a bottomless glass flask and inverted it. The neck was fitted with a cork perforated so as to admit the passage of a glass tube. Into this glass tube was fitted, by means of shellac gum, a second tube of platinum. A current of cold water was kept constantly circulating through the inside of this platinum tube by means of flexible india rubber pipes. The flask was filled with acidulated water to a certain level over a millimetre above the upper end of the glass tube fitted into the cork, so as to be in contact with the platinum tube proceeding from the latter by a narrow annular space. A split ring of platinum plate, enclosing the glass tube, served for the positive electrode of the current, and the platinum tube for the negative one. On passing the current from 90 or 100 Bunsen pairs through the cell thus constructed, a very intense light was produced at the annular space, where the negative platinum tube was exposed to direct contact with the liquid. The latter tube being very thin in the material, and constantly washed by the stream of cold water flowing in its interior, could not possess a higher temperature than that of the cold water, and therefore could not generate an insulating couch of steam.

It is more natural to seek the cause of the production of the vapour not in the high temperature of the electrode but in that of the liquid immediately surrounding it. In fact, the conductivity of the metal wire serving for electrode being very great, compared to that of the liquid, the wire may be considered, over the whole of the immersed part, as having the same potential at all points. Hence, if we imagine a thin film of liquid surrounding the electrode, it will be traversed by the current in the normal direction, and, in consequence of its small surface and comparatively bad conductivity it will present a considerable resistance to the passage of the current, and the heat generated may, after a little time, serve to bring the liquid to the boiling point. A very simple calculation approximately proves that, with a battery of 100 Bunsen cells, acidulated water containing 5 per cent. of sulphuric acid, and an electrode of 10 millimetres surface, it would only require an interval of 1·3 seconds to raise the liquid immediately surrounding the electrode from 20° C to 100° C, that is, the boiling point. It is, of course, plain that this time could be still further reduced if the liquid were warmed beforehand.

As the electrolysis never completely ceases the electrode is always surrounded with gas, which may serve as a beginning for the formation of the vaporous cushion. The latter once formed, the discharges take place by sparks, and almost all the heat developed by the current is disengaged in the cushion, and goes to warm the surrounding liquid as well as the electrode, if the latter is not artificially cooled, as in the above experiment.

The process adopted by M. Righi for producing the light in the midst of the liquid speaks in favour of this explanation of M. Colley. There the liquid in the narrow aperture presents a great resistance, and is consequently heated and vapourised when the current passes in the form of sparks across the gaseous breach in the circuit.

AN ELECTRIC OIL TESTER.

The estimation of petroleum oil by igniting its vapour with the electric spark is a novel application of electricity for which we have to thank the Americans. One of the most recent and best electric oil testers is that of Mr. Pease, which is illustrated in the *Scientific American* for May 22. It consists essentially of an induction apparatus for generating the electricity, and a discharging cell containing the oil and its vapour, and the sparking points.

The discharging cell consists of a closed brass chamber, fitted with binding screws and electrodes brought close together, so as to discharge across. In this chamber is placed a cup containing the oil to be tested, and the vapour is made to rise from the oil and impregnate the air around the points by the application of heat. This heat is applied by means of a can of hot water, on which the discharging cell is supported; and the water is kept hot by a gas or petroleum flame burning underneath it. A thermometer is inserted into the oil to indicate its temperature, and an overflow pipe leads from the side of the oil cup near its top, and has a slight bend or curving trap formed in it, to prevent the escape of vapours driven from the oil, while it admits of the overflow of the oil in case of its expansion, and always keeps the oil at a uniform height. The induction coil furnishes a constant means of igniting the vapour driven from the oil without admitting air; and a switch is added to reverse the current, or otherwise alter the discharge.

The ordinary closed and open test now in general use in America is not strictly correct, owing to the fact that there is no standard as to the intensity of the fire to be applied to ignite the vapour, and no restrictions as to where the light is to be applied. The new electrical test obviates all these difficulties, and secures tests which are always the same and absolutely correct to a fraction of a degree. It determines the expansion of the oil, accounts for, corrects, and measures it; also prevents the escape of the hydro-carbon vapour, and regulates and keeps the oil at a fixed height and exact distance from the point of combustion, conditions never before secured. The electrodes are so arranged as to detect the vapour in its minimum quantity, and at any point relative to the surface of oil, the igniting points being, as we have remarked, always at a determined distance from the oil. In testing refined oil the ordinary quantity used for the oil bath is about 3¼ fluid ounces, equal to 91·14 grammes.

Mr. Pease finds that refined petroleum oil is a good if not a perfect non-conductor of electricity, and that by adjusting the two poles to 0·32 of a centimetre apart, and placing them in the oil, a discharge from a powerful induction coil will not go through the oil, but will discharge between the two poles out of the oil when 1·92 centimetres apart. This fact enabled Mr. Pease to arrange a test to a minimum by putting one pole in contact with the oil with its point projecting upward to the downward projecting point of the other pole, a moist surface of sufficient size being provided for the vapour.

THE TELEPHONE COMPANY (LIMITED).

An extraordinary general meeting of the members of the Telephone Company (Limited) was held at the Guildhall Tavern, Gresham-street, on Tuesday, the 1st inst., Mr. James Brand presiding, for the purpose of considering, and if approved of, passing the following resolution, as an extraordinary resolution pursuant to the 82nd section of the articles of association of the Company:—"That an agreement, dated the 13th day of May, 1880, and made between the Telephone Company (Limited) (thereinafter called the Bell Company), of the first part, the Edison Telephone Company of London (Limited) (thereinafter called the Edison Company), of the second part, and a trustee for and on behalf of a company intended to be registered under the name of the United Telephone Company (Limited), of the third part, being a conditional agreement for the sale to the United Telephone Company of the business, goodwill, and property of the Bell Company, and of the Edison Company respectively (except as in the said agreement mentioned), for shares in the United Company, be confirmed; and that the directors be empowered to do all such things as may be necessary for carrying such agreement into effect, and for making an ultimate distribution of the shares of the United Company among the members."

The SECRETARY (Mr. W. T. Johns) having read the notice convening the meeting, as above,

The CHAIRMAN said he had very few remarks to make to recommend the resolution to their confidence. They had all felt since these two telephone companies were started that there were enormous difficulties in the way of the successful furtherance of their business, because the most profitable part of it they believed would be the central system; and when there were two rival companies, using two different sorts of instruments for the same purpose, and with different subscribers, it not only limited the gross number of subscribers, but caused competition for rates of subscription and enormous difficulties with respect to way leaves. This Company was in possession of the Bell patent, and the Edison Company were possessed of their own instrument, about which they (the Bell Company) did not think very much, but the Edison Company also had the property of the carbon transmitter, and it was the carbon transmitter which they thought was necessary for the completion of the central system, so that this Company having the undisputed possession of the best receiver, and the other company having the property in the best transmitter, they thought the wisest course was to avoid all future competition, bring their rates to one point, and amalgamate, and it was for that purpose that they had asked the shareholders for their attendance on that occasien, to consider the proposal re-

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ferred to. They had no doubt whatever on the subject themselves, that it would be for the mutual advantage of both companies, and they hoped by this means that they would command all the telephones known and patents, or the most important of them now known, and they would therefore ask the shareholders to give their assent to the resolution. Mr. Crisp (the solicitor) would explain the agreement. He then moved the resolution.

Mr. J. S. Forbes, in seconding the motion, said the importance in an enterprise of that kind of having unity of administration and purpose—both of which had in themselves very valuable elements—must be obvious to them. The Board, especially the chairman, had devoted considerable time and energy to the negotiation of the agreement, and they believed they had made a bargain which was likely to be satisfactory to both sides, inasmuch as it was a fair one, and recognised the value of the property of both concerns. He believed they were unanimous in recommending it to the cordial approval of the shareholders.

Mr. Crisp said he might state that the general effect of the agreement was that the Bell Company on the one hand and the Edison Company on the other transferred to the new United Company all their property and assets with one exception, which he would afterwards mention, for the following consideration:—The Bell Company would receive £200,000 in in fully paid up shares of the capital of the United Company, and the Edison Company would receive £115,000, also in shares of the United Company. Each company sold its entire assets with this exception—that the cash now in the possession of either company, or any debts due to it, or any money coming in from calls would not be sold. In the case of this Company there was a considerable sum in their hands which would be applicable either for division or for dealing with hereafter. He then explained in general terms each clause in the agreement, observing in the course of his remarks that the companies which this Company was in agreement with now would not have the benefit of the Edison patent by reason of the transfer. The new company would take the liability, as they would get the benefit of the action between the Post Office and the two old companies. The 15th of June was the day on which the matter was to be completed, but the sale was to take effect as from the 1st May last. If the matter were not completed before the 30th of June it would fall to the ground. The agreement might be modified from time to time as the Boards of the hree companies might decide.

Mr. Hubbard, the late president of the American Bell Company, said that the proportion on which the transfer was to be effected was in the present case 200 to 115. In America the Edison patents were held by the Western Union Telegraph Company, who received 20 per cent. of the net profits and possessed the right to use the telephone for their telegraphing business. He should, therefore, think that substantially the terms were the same in the present case as those on which the Edison Company was taken over in America by the American company. He might add that in America the telephone was considered as a necessary adjunct to the telegraph system, not as forming part of the telegraph system but as something entirely indistinct, though connected to it.

The Chairman, in reply to further questions, said that no arrangements were pending between the Company and the Post Office—there was an action pending with all the telephone companies. A great many negotiations were entered into respecting the subject, and they were continued from month to month, but they had ended as they now saw. They could not accept the terms of the Post Office, as they thought they would "kill" them.

Mr. Crisp, also in reply, stated that they were advised that the Post Office had no justification for their claim. It was provided that whatever arrangement now existed between the Bell Company and district companies, that and no more would be taken over by the United Company.

In answer to Mr. Galsworthy,

The Chairman said that by the amalgamation the subscribers would get the advantage of being able to use both instruments if they chose, and to talk to a great many more people for no more money.

Mr. Galsworthy thought that the whole of the details might be left in the hands of the Board, who, he felt sure, must have given a great deal of time and attention to the matter. So long as there were two distinct companies working with apparently the same object but with different means, so long did they prevent a vast number of people from adopting either company, and when there was simply one focus, then he thought the number of subscribers would naturally be immensely increased. He supported the resolution.

The Chairman, in answer to a shareholder, said that the matter would have come about long ago if they had given the Edison Company £200,000, and they themselves had received £115,000. The boot was on the other foot. It took some degree of persuasion to induce people to take the smaller sum and to give the other side the larger sum. The intention as to the new company was to offer the fresh capital to the shareholders of the Company and to the subscribers to the central systems—the general customers. He then put the motion, and it was carried unanimously.

On the motion of Mr. Galsworthy, seconded by Mr. F. A. Gover, a vote of thanks was passed to the chairman and directors.

The Chairman, on behalf of his colleagues and himself, expressed his acknowledgments, and said that it had not been without difficulty and trouble that all these negotiations had been brought to an end; but if the amalgamation of the companies led to the success they hoped, they would feel themselves amply repaid for their trouble.

Mr. Crisp, in reply to a question, said that a confirmation meeting would not be necessary.

The proceedings then terminated.

THE EDISON TELEPHONE COMPANY OF LONDON (LIMITED).

An extraordinary general meeting was held on the 1st inst. at the offices of Messrs. Price, Waterhouse and Co., 44, Gresham-street, E.C., when a resolution agreeing to sell the business, good-will, and property of this company to the United Telephone Company (Limited), and to empower the directors to carry such sale into effect, was considered.

[The resolution was similar to that referred to in another column as discussed at the meeting of the Bell Company's shareholders.]

The chair was occupied by the Right Hon. E. P. Bouverie.

The Secretary (Mr. Arnold White) having read the notice convening the meeting,

The Chairman moved the adoption of the resolution, and spoke of the advantages of the agreement, pointing out that it would lessen the expenses of management, and remove other difficulties attendant on competition. The amalgamation would also tend to insure the support of the mercantile community.

Mr. W. Fowler, M.P., having seconded the motion, a short discussion followed, and in reply to questions,

The Chairman stated that in order to carry out the agreements with Mr. Edison, the company would continue to exist, and the shares would be held in trust on behalf of the shareholders.

The resolution was carried unanimously.

On the motion of Mr. T. Porter, seconded by Colonel G. E. Gouraud, a vote of thanks to the Chairman was passed, and the preceedings terminated.

ABSTRACT OF PATENTS.

3831. Protecting and Insulating Underground Telegraph Wires, *P. Jensen.—Dated 23rd September*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d*.

The wires are enclosed in a metallic projecting pipe having an interior insulating tube made in sections with close connection joints. This tube is made of asbestos, glass, fibre, slagwool, or mineral fibre.

3875. Electric Lighting, *C. W. Harrison.—Dated 25th September*, 1879. 6*d*.

The carbon burners are composed of pure lamp-black and naphthaline dissolved in boiling tar, and kneaded together to form a mass that is compressed in heated moulds, and afterwards packed with powdered chalk in clay crucibles and burned at a high temperature. A regulator is made of a mixture of lamp-black and chalk, the top part being all lamp-black and the bottom all chalk, and the intervening parts consisting of varying proportions of both to represent successive units of resistance. These are moulded into slabs and baked in a close crucible, and when ready are fixed in a dial communicating with the circuit, whilst an adjustable slide also in communication makes contact with the various slabs and controls the passing current. Various forms of lamps are described. The electric light is concentrated into a channel and issues through slots therein.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 2.		Business Done Week Ending June 2. Highest.	Lowest.
Anglo-American Ordinary	59¾,	60¼	62⅝	59½
Do. "B"	90,	½	93	89½
Do. "A"	32⅜,	33¼	34⅜	32¼
Brazilian	8¼,	⅜	8⅜	8 3-16
Cuba	9,	½	9½	9½
Do. Ten per Cent. Pref.	15½,	16½	16¼	16¼
Direct Spanish	1⅜,	2⅛	—	—
Do. Ten per Cent. Preference	10⅜,	11¼	—	—
Direct United States	10¾,	11	11⅝	10¾
Eastern	8 15-16,	9 1-16	9⅜	8 15-16
Do. Six per Cent. Debenture	102,	104	—	—
Do. Five per Cent. do.	102,	104	103⅝	103⅝
Do. Six p Ct. Preference	12½,	⅛	12⅜	12⅜
Eastern Extension	9 1-16,	3-16	9 3-16	9
Do. Six per Cent. Deb.	107,	110	—	—
German Union	8¼,	9	—	—
Globe Telegraph & Trust	5⅞,	6	6 1-16	5⅞
Do. Six p Ct. Preference	11⅜,	12	12¼	11¼
Great Northern	9⅛,	¾	9¼	9¼
Indo-European	22½,	23½	—	—
Mediterranean Extension	2¾,	3⅛	—	—
Do. Eight per Cent. Preference	10¾,	11¼	—	—
Reuter's	9½,	10½	—	—
Submarine	235,	245	238	237
West India and Panama	1⅜,	⅝	1 11-16	1⅜
Do. Six per Cent. Preference	7¼,	¾	7 7-16	7⅜
Western and Brazilian	6¼,	¾	7⅛	6⅝
West. Union 7 p. Ct. 1st Mt.	117,	122	—	—
Do. Six per Ct. Sterg.	103,	105	—	—

TRAFFIC RECEIPTS FOR MAY, 1880.

Companies.	May, 1880.	May, 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	—	—	—	—
Direct Spanish Telegraph Company	—	—	—	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,963	38,371	4,592	—
Eastern Extension Telegraph Company	26,570	25,845	725	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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SLIP

UNDERGROUND WIRES IN GERMANY.—The administration has 2,274 miles of line, consisting of 17,380 miles of wire.

PROF. D. E. HUGHES.—As will be seen from another Note, this gentleman has been elected a Fellow of the Royal Society.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The address of this company is now 19, Great Winchester-street, E.C.

THE FAULT IN THE NEW FRENCH CABLE.—The *New York Herald* suggests that the injury to this cable may have been caused by large rocks brought down by icebergs.

ELECTRIC BREAKS.—The Achard electric break is being tried in France, and is said to be successful. Planté's accumulating battery is the one used in connection with this break.

INDIANA.—Mr. C. Reitz is getting ready an electric-light apparatus for the Medical College of Indiana. It is to be of 2,500 candle-power. The motor will be a $2\frac{1}{2}$ H.-P. Gas Engine.

SARATOGA.—The Grand Union Hotel at Saratoga Springs will have the main tower lighted by two electric lights. This example might well be followed by some of the large hotels at our fashionable watering places.

THE TELEPHONE IN BELGIUM.—An experimental trial of the Bell telephone between the Hôtel Communal and the fire station at Liège has been, says the *Indépendence Belge*, so successful that a network of lines will, no doubt, be established for the public service, and will be augmented by private enterprise.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).—The number of messages passing over the lines of the Cuba Submarine Telegraph Company (Limited) during the month of May was 2,540, estimated to produce £2,900, against 2,782 messages, producing £3,108 in the corresponding month of last year. The traffic receipts for the month of March, estimated at £3,500, realised £3,586.

LA LUMIERE ELECTRIQUE.—The current number of our able contemporary contains articles by Th. du Moncel on "Mesureurs Electriques des Niveaux d'Eau;" by M. A. Angot on "La Météorologie Télégraphique;" by E. Hospitalier on "Machine Dynamo-Electrique de M. Bürgin;" by M. F. Geraldy on "Les Eclairages Electriques à Paris;" by M. de Magneville on "Nouveaux Régulateurs de l'Arc Voltaique—Petite Course;" Revue des Travaux Récents en Electricité, Correspondence, &c.

JOURNAL OF THE SOCIETY OF TELEGRAPH ENGINEERS.—The current number contains some interesting information concerning the extent of the use of the Jablochkoff light. According to M. Besly, a total of 1,716 lights are in use, of which 465 are in Paris, 428 in the French Provinces, 198 in England, the remainder in various other countries. In this number will be found papers on effects produced by "The Immersion of Steel and Iron Wires in Acidulated Water," by Professor Hughes, and "On the Adhesion of Metals Produced by Currents of Electricity," by Mr. Stroh.

ELECTRIC LIGHTS ON BUOYS.—"The whistling buoys now in use weigh about fifteen tons each, and in their plunging, even during calm weather, a force of nearly three horse-power is evolved. To utilize this waste energy Mr. Edison has devised a small dynamo machine, to be carried by the buoy, the current from which will sustain an electric light equal to one gas jet. If successful, these self-illuminating buoys must be of great use to mariners." We quote the above from our contemporary the *Scientific American*, which, however, gives no explanation as to *how* the energy is to be utilised. Ideas of this kind are cheap, but the means of carrying them out are by no means so easily hit upon.

DOUBTING PROGRESS.—The St. Louis *Journal of Commerce* says:—"In the eight years from 1790 to 1798 there was as much real progress made with the root and stem of electricity as there has been in all the years since, because both the production of electricity and chemical decomposition were known and applied, Salva in 1798 working a line twenty-six miles long with frictional electricity. In the eight decades since, we have only added the so-called dynamo-electricity. The balance of the labour bestowed upon the science has been in the perfection of the details touching the use of the fluid in a multitude of ingenious ways after it has been produced, and the perfection of these details has been the chief source of the benefits we have derived."

THE ROYAL SOCIETY.—The following is a list of the gentlemen who were elected Fellows at the meeting of the Royal Society, on Thursday, June 3:—Thomas Clifford Allbutt M.A., M.D., F.L.S.; Professor John Attfield, Ph.D., F.C.S.; Henry Francis Blanford, F.G.S.; the Rev. William Henry Dallinger; William Turner Thiselton Dyer, M.A., F.L.S.; Lieut.-Colonel Henry Haversham Godwin-Austen; The Right Rev. Charles Graves, D.D., Bishop of Limerick; Professor David Edward Hughes; Henry M. Jeffery, M.A.; Professor Frederick M'Coy, F.G.S.; J. Fletcher Moulton, M.A.; Professor Charles Niven, M.A., F.R.A.S.; John Rae, LL.D.; Professor J. Emerson Reynolds, M.D.; William A. Tilden, D.Sc. Of these Professor Hughes is well known to our readers as an eminently practical electrician.

CABLEGRAMS.—The Anglo-American Telegraph Company (Limited) have notified that the rate for the transmission of telegrams, *viâ* the lines of this company from the United Kingdom to New York, East and West Canada, and Newfoundland, is reduced to 6d. per word. The reduced tariff to places situated in the following States is also announced by the same company:—

	s.	d.		s.	d.
New York	0	6	Michigan	0	6
All other places (in the State)	0	7	Minnesota	0	11
California	1	4	Missouri—		
Dakota Territory	1	4	St. Louis	0	6
Illinois	0	9	All other places	0	11
Iowa	0	11	Ohio	0	9
Maine	0	6	Oregon	1	4
Manitoba Territory	1	4	Wisconsin—		
Massachusetts	0	6	Milwaukee	0	9
			All other places	0	11

SEDLACZEK AND WIKERLILL'S REGULATOR LAMP.—This lamp, a long description of which appears in the *Zeitschrift fur Angewandte Electricitatolehre* (No. 6, 1880), is only a modification of the regulators of MM. Lacassagne and Thiers, Duboscq and Marcais, invented in 1855, and described in the 5th vol. of Du Moncel's *Exposé des Applications de l'Electricité*. As in the case of these regulators, the motion of the carbons is due to the hydrostatic action of a fluid standing at a different level in two vessels communicating with each other; the velocity of the flow from one to the other being controlled by an electro-magnetic arrangement. The only difference that can be pointed out is that in the new apparatus the two carbons move simultaneously in consequence of the hydrostatic action, whilst in the old forms of lamp it is the lower carbon only that moves.

CABLE COMPETITION.—The *St. James's Gazette*, discussing the "war of rates," says:—"A new cable war has broken out. The French Company being ready to begin working,

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and having fixed their charges at 2s. a word, the Anglo-American Company retaliate by a reduction on their own lines to 6d. a word, and on the 'Direct' line amalgamated with them to 2s., the object evidently being to secure express messages for this latter line while the other lines are blocked by the influx of business at the sixpenny rate. But the war is most lamentable on account of the depreciation of cable property which it involves. . . . There can be no monopoly in ocean telegraph property, and when existing companies combine their only chance of averting new competition is to keep their rates low; if they do not, the demand of the mercantile world for cheap telegraphic communication with America will bring out a constant succession of competitors."

Dr. Mandon's Regulator Lamp.—In this lamp also, the object of the inventor is to dispense with all clockwork by utilising the hydrostatic action of a fluid, which in this case is mercury. The carbons are of circular curvature; and the light is produced between two of the extremities, which are in proximity, and which are tangential, or terminate two radii in the same straight line. As the carbons are consumed, the reduction in their weight causes them to rise so that the extremities constantly occupy the same position. This lamp is stated to work well with alternating currents; but, with the continuous current, contact between the carbon, was found to be produced by the material transported from the positive to the negative electrode, with the result of extinguishing the light. The regulator occupies much space, and requires a locus free from any vibration; it is, however, likely to be considerably improved by the inventor.

Experiments in Magnetism.—An interesting experiment in magnetism has been described to the French Academy by M. Obalski. Two magnetic needles are suspended by fine threads attached to unlike poles over water in a vessel. Their distance from each other is a little greater than the sum of their radii of mutual attraction, and their poles are opposite each other. The water is gradually brought up over them by means of the tube of caoutchouc connected with the vessel and wound on a drum. When immersion commences the needles approach each other by their immersed parts, and when the immersion has reached the third or fourth of the needle's length they go together. The explanation seems to be that what hindered the approximation of the needles was their own weight, and the force of gravity being weakened by the immersion the magnetic forces become manifest. A corresponding, though opposite, phenomenon is witnessed when the needles are suspended by their poles of the same name.

Russian Telegraphic Tariff.—The Russian Government has recently approved of a new home tariff in substitution for that of 20 words. According to the new system, which it is intended to introduce on July 1, of the present year, the territory of the empire will be for telegraphic purposes divided into three parts. The first includes the whole of Russia in Europe to the meridian of Ekaterimbourg, including Russia in the Caucasus; the second Russia in Asia as far as the meridian of Stretinsk, including Turkestan; and the third all the territory included between this meridian and the extreme limits of the empire in the East. Each of these three portions is again divided into three zones; the first having a radius of 200 versts (the verst = 1067 metres); the second a radius of 1,000 versts; and the third including all the remaining space The charge will be based upon a minimum of 10 words, for which 30 copeks will be paid in the first zone, 60 copeks in the second, and 1 rouble 20 copeks in the third. For every word above the ten, the charge will be $2\frac{1}{2}$ copeks in the first zone, with the proviso that, in order to avoid fractions, the total is always to be made up to an even number of copeks. In the second zone, the charge will be 5, and in the third 10 copeks. In regard to telegrams between any two of the above-mentioned three divisions, the total charge will include all the separate charges of the intervening territory.

Menlo Park.—The *New York Herald* has the following anent the work at Menlo Park. Probably this will be found to be an evolution from the inner consciousness of the *Herald* reporter. At any rate, it is on a par with the general work of the *Herald* :—"When the large gearing wheel of Edison's electromotor burst about one week ago he at once set to work and devised another mode of transferring the power (generated by the revolving armature) to the wheels. He had three wooden pulleys made, and connected them by belting, the pulleys being so proportioned as to get a good velocity at the turning shaft. He was 'cruising' up and down his three-quarter mile railroad on Friday last when notice came that the officers of the Austrian corvette Saida were approaching. He at once began to show them everything worth seeing in and around the laboratory, and, after the visitors were satisfied with examining the novelties, he gave them a ride on his new railroad. The distinguished party, or at least some of the principal members of it, took seats on the car that is attached to the motor. A small lever was moved connecting the circuit, and away they went. The speed attained while going round the curves was anything but pleasant to those on the cars, but, although the road is new and is very indifferently built, no accident occurred. The party returned by a late train to the city, feeling that they had seen one of the many wonders of the Republic. Mr. Edison proposes to build an additional mile and one-half, in which there will be one grade as steep as one foot in every six and three quarter feet. This will be into a deep gully and up the other side. His intention is to show that a train can be run wherever a horse can draw a waggon. Edison being very busy on Saturday, the reporter went in search of Dr. Haid, his chief metallurgist, and obtained from him all the news relating to the gold tailings process. The Doctor said that since the Herald published a description of the work there have been thousands of samples of ore received. Many of them are, of course, worthless, but a great many have been found rich in gold in several forms, such as tellurite of gold, float gold and free gold. There are also many samples containing large quantities of nickel, uranium, vanadium and platinum. Menlo Park has evidently become the central assay office of the country."

A New Telegraph Code.—Mr. A. C. Baronio sends us the prospectus of a new telegraph code which he has compiled. We have not seen the code, and quote the author's first paragraph with due reservation. He says :—"This vocabulary, though peculiarly adapted for a system which I intend to bring more fully before the public in due time, may be advantageously applied to any other code already in existence, and its pages can simply be set off in a variety of tables useful for almost any requirement. Although I started this work fully three years before the International Telegraph Conference of London, 1879, their rules greatly enhance its value rather than otherwise affect it. Each word is absolutely free from objectionable manipulations, and may be found in Webster's or Nuttall's Dictionary. Practically, in fact, it exhausts the English language, every telegraphically suitable word (under the limit of ten letters) having been taken from it; and no trouble has been spared on my part in studying both the interests of telegraphic administrations and the public in general, so far as my humble capacity has enabled me to investigate the subject. These two interests are not antagonistic as it is commonly supposed, and, if any

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antagonism exists, it can only be traced to fallacious rules. The following are the principal advantages embodied in the system above referred to:—1. Great capability of extension with a limited number of ciphers. 2. Absolute reliability. 3. Universal adaptability. 4. Simplicity and a great saving of time in composing and reading code messages. 5. Perfect secrecy as a matter of necessity. 6. Utmost economy both in the printing of codes and the cost for transmitting messages. 7. An abiding principle, not likely to be disturbed by any change of rules at the next or subsequent telegraph conventions. To fully substantiate all these distinct claims, I would have to accompany my remarks with some specimens not necessary in this publication, which is intended merely to supply the public with a number of useful ciphers that can be used in many ways. Most merchants are already supplied with a code tolerably well suited for their present requirements, and it will naturally be difficult to persuade them to adopt a change; but I may observe, that the adoption of my system will not necessarily interfere with the working of any other code."

Theory of the Microphone.—Professor Challis, in a supplementary paper on the Hydrodynamic Theory of Physical Forces, says:—"The theory of the microphone I am about to propose is a corollary from that of the telephone given in the *Philosophical Magazine*, for June, 1878. The following mode of producing the phenomena of the microphone, which was conducted in my presence, is convenient for describing the theoretical explanation. An oblong rectangular plate of charcoal of moderate breadth and small thickness was approximately balanced about its middle transverse section, and so placed that the end of its heavier half rested slightly on another plate of charcoal of greater breadth. An arrangement was made by which the electric current pertaining to a telephone could be passed through the two pieces of charcoal. Although my hearing is not good, words transmitted from a distant room were heard with sufficient loudness and distinctness by employing the telephone in the ordinary way, and applying a receiving cup to my ear. But as soon as the current was made to traverse the pieces of charcoal the loudness and distinctness were marvellously increased, and I had no longer need to apply the cup. This increment of sound may, I think, be accounted for, on the principles of the hydrodynamical theory of the telephone, in the following manner:—The current, in passing out of the narrower into the broader plate, enters into a larger channel, and consequently, according to the hydrodynamics of steady currents, its velocity is there diminished and its density increased. The increment of pressure thence resulting might suffice to raise the narrow plate; but if so, a very slight separation would so far intercept the current as to cause a diminution of the lifting force, and the plate would immediately be brought back by the force of gravity. Thus, a quick succession of partial interruptions would be produced whereby the steady motion might be partially converted into vibratory motion. This effect would be precisely analogous to the generation by the siren of Cagniar de la Tour of musical sounds by means of a succession of interruptions of a steady current of air, the pitch of the sound increasing with the velocity of the current. These vibratory motions, being an accession to those produced by the speaker at the transmitting end of the telephone, and having a constant relation to them, are attended by an accession of current, and therefore an accession of effect at the receiving end. This follows from the analytical formula in the second paragraph of the article in the *Phil. Mag.* for June, 1878, the effects under consideration being all referable to pressures depending upon the squares of the velocity of a steady current of the aetherial medium."

Mangabeira Rubber.—The largest quantity and the best quality of rubber, says the *Journal of the Society of Arts*, has hitherto been imported from the province of Para, Brazil, and although it has long been known that other provinces of that vast empire contained forests of rubber-yielding trees, these have never been taken advantage of, owing to the ignorance or supineness of the natives. The inhabitants of the province of Pernambuco are now beginning to realise the vast stores of undeveloped wealth existing in their virgin forests, and rubber is being exported from that province, which may soon rival Para in the extent of its exports of this article. This action is almost entirely due to the exertions of Senhor Joao Fernandez Lopes, who has spared neither time nor money in his endeavours to improve the agriculture of the province, and to develop its vast stores of natural wealth. This gentleman has issued a circular (dated April 26th, 1880) calling attention to this important source of wealth, and giving practical instructions for the collection and preparation of the rubber, from which the following is extracted:—"Mangabeira rubber is the most suitable for the springs of railway waggons, tramway cars, and different machines, and for an infinity of other purposes. The process of extracting the milk from the mangabeira tree is very simple and easy. Each person must be provided with fifty or more small tin basins and a small axe. He should make eight oblique cuts, sloping downwards, at a little distance from each other, all round the trunk of the mangabeira, cutting only the bark, and placing immediately below each cut one of the basins, securing these either with adhesive clay or nails. These small basins will collect the milk that exudes from the cuts, and, when full, they must be emptied into a larger vessel. This process should be continued during the whole day, and thus three or four bottles of milk may be collected, according to the fertility of the trees. The cuts should not be deep, as the milk is secreted just below the outside bark; and a great number of incisions should not be made on each tree, as these may weaken or kill the trees, which has been the case, in some instances, with the seringueira, the tree from which the Para rubber is obtained. The Para rubber is made in the place where the milk is collected, because, in the process of preparation by smoking, there is not time for the milk to be carried to the houses of the collectors; but here we do not prepare the rubber as they do in Para, but make use of the process introduced into the province of Para, in 1860, by Senor Strauss, which, being much simpler, gives admirable results. The process is as follows:—Put a little powdered alum into a teacup full of water, mixing it well, then put a few spoonsful of this solution into a vessel in which three bottles of the milk have been placed, properly strained, to clear it from any extraneous matter. Immediately the milk coagulates, which will be in two or three minutes, the rubber must be exposed to the air on sticks and allowed to drain for eight days. After thirty days it is ready to send to market in cases or barrels. We have tens of leagues of mangabeira trees, and long ago we might have made use of this wealth, according to the opinion of Senhor Joaquino d'Almeida Pinto, an intelligent botanist of this province. The seringueira planted here grows perfectly, and there is no lack of different milk-giving trees that might be made useful. The province of Para exported last year three million kilogrammes of rubber, valued at six thousand coubos (£600,000.)."

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REPORT.

According to the *Manchester Examiner* the Postmaster-General has decided to re-adopt the system of sixpenny telegrams. Is it not a little singular that such a report should emanate from a country paper? Perhaps the London correspondent of the *Manchester Examiner* has the ear of the Postmaster-General, who desires the support which may not be forthcoming from the leading London papers. We cannot say whether the report is founded upon fact or not. The probability is that the wish has been father to the thought, and that the tariff will remain unaltered. In a short time cheap local telegrams may be possible; at present we fear the revenue would suffer too much for their introduction. When telephone lines become general, local telegrams will be things of the past, and a change of rate will make little difference to the total receipts. It must always be remembered, as we have over and over again pointed out, that the cost of a telegram to the next street differs very little from the cost of a telegram to Manchester, Edinburgh, or Glasgow, if we do not consider the first cost of erecting lines. There are greater evils than shilling messages to remedy before the telegraph service is rendered perfect, and we expect other improvements stand before this on the rota.

On another page we give an instructive tabular statement relating to Submarine Companies, compiled by Mr. L. Wells, than whom no man is more competent for the work. The careful consideration of this table will show what we have so long and so often urged, that unlimited competition in cable work is ruinous to all concerned, except perhaps the contractors and promoters. Viewed with this table before us, we as strongly as ever condemn the action which has led to the laying of a new Atlantic cable. This new company, indeed, has not only done its best to ruin others, but has made every effort to ruin itself, and so far successfully. Its agreements are altogether contrary to those justified by the well-known laws of economic science. Traffic which ought to pay equally with, if not at a higher rate than commercial, goes free, and it allows an independent government to regulate its tariff. The fight which has commenced with the old companies can have but one termination. The first cost is very large, dividends extremely problematical, depreciation of capital only too real. And this from men who pride themselves upon their business tact.

That part of the report of the visitants to the Royal Observatory which refers to electrical questions, states that the Deal time-ball was not dropped exactly at the right time on three days of the year, owing to failure in the telegraphic connection. One day it was 4 sec. too soon by telegraph signals, another day 9 sec. too soon, and on 29 days the current refused to act when an attendant released the trigger. Now, we have little fault to find with the work at Greenwich Observatory, but we might suggest that the time-ball signalling apparatus is somewhat antiquated, and that since its adoption improvements have been made which, if introduced at Greenwich, would render such a statement as the above of exceeding rarity.

Last year it seems that Commander Green, U.S.N., came over to this country for the purpose of determining telegraphically the longitude of Lisbon, as part of a chain of longitudes extending from South America to Greenwich. A successful interchange of signals was made between Greenwich and Porthcurnow on four nights, viz., June 25 to 29. The results communicated by Commander Green show that the longitude of Lisbon Observatory, as adopted by the *Nautical Almanac*, requires the large correction of + 8·54 secs.

The British Museum report just presented to the House of Commons speaks favourably of the use of the electric light in the reading room during the winter months.

ELECTRIC RAILWAY.—M. Boué, *sous-intendant militaire* at Belfort, claims to have been the first to suggest an electric railway. He took out a patent in 1878, in which he discusses not only the traction of carriages on rails, but the division of the electric force between several carriages.

A PRELIMINARY ACCOUNT OF THE REDUCTION OF OBSERVATIONS ON STRAINED MATERIAL, LEYDEN JARS, AND VOLTAMETERS.*

BY JOHN PERRY AND W. E. AYRTON.

It has been shown by Dr. Hopkinson that if two Leyden jars be made of the same glass, but of different thicknesses :—

1st. If they be charged with the same difference of potential for equal times, discharged for equal times, and then insulated, that the residual charge will, after equal times, have in both cases the same difference of potential.

2nd. That residual charge is proportional to exciting charge. These propositions may be included in one law—the superposition of simultaneous forces is applicable to the phenomena of residual charge. All the investigations in Dr. Hopkinson's paper in the "Transactions of the Royal Society," vol. 167, part 2, serve to prove this law, and, so far, they support the theory of residual charge, which we owe to the late Professor Clerk Maxwell. We should, therefore, be inclined to think that one of the best methods of investigating the relation between the relative powers of different glasses to possess residual charge would be simply to charge jars made of these glasses for the same great length of time, discharge for the same short intervals, and insulate, measuring in each case the time increase of soaking out of the residual charge. Whatever the thickness of the glass or the amount of the original charge, we know that the same glass will always give the same proportion of residual charge at the same times from insulation. Any change of the state of the glass caused by heat would be shown as a change on the curve of increasing residual charge, &c. There seems to be no doubt that this method would give what may be called a measure of the specific power of producing residual charge phenomena of the glass experimented on.

In this way, since 1875, we have obtained a considerable number of curves for residual charge in condensers of different dielectrics at different temperatures, and so we may say that we have measured the power of producing residual charge phenomena in the substances experimented upon in different states, and this power, which we call our "residual-charge-function," ought, according to Dr. Hopkinson, to be constant for the same substance at the same temperature. Thus, if v_t is the residual charge at the time t after insulation, and if V was the original long continued charge, $v_t \div V$ is our residual-charge-function for the time t, which we may designate by F_t. Of course, it is evident that if F'_t is our function for a different dielectric, then $F_t \div F'_t$ is not necessarily the same as $F_{t'} \div F'_{t'}$; in fact, the residual-charge-function is only completely specified when a table is given of its values at different times after insulation. We have used the same name and symbol in the experiments we have been simultaneously making during the last five years on strained wires and beams, and on voltameters and magnets, and of course there is always the difficulty experienced by Dr. Hopkinson with his more complicated function "ψt," which renders it necessary to give a table of values instead of only one value of the function. Thus, for two particular kinds of glass, Dr. Hopkinson finds—

$$\frac{\psi(5) - B}{\psi'(5) - B} = 3{\cdot}5,$$

whereas

$$\frac{\psi(60) - B}{\psi'(60) - B} = 6,$$

showing how with the same two glasses the ratio is affected by varying the time from 5 to 60. Again, also in his investigation of the influence of temperature on residual charge in the same glass, he finds that at 175° F. the values of $\psi(1) - 13$ and $\psi(5) - 13$ are respectively 0·38 and 0·034, with a ratio one to the other of 11; whereas the values of these functions at 108° F. are 0·155 and 0·05 respectively with a ratio one to the other of 3·1. This method of measurement is subject, therefore, to exactly the same objections as the easier method of which we have spoken; in fact, we are not aware that hitherto any method has shown itself to be better than actually giving the curves of rise of potential after insulation, or the curves of change of current during charge and discharge of a condenser. This is the method which we have found the easiest for the discussion of such phenomena, and we may direct attention to such curves for voltameters in a paper communicated by us to the Society of Telegraph Engineers, and which appeared in their *Journal*, vol. v, 1877, Nos. 15, 16, p. 391. Curve EFGG' there shown, in Fig. 4, p. 396, is especially interesting, as we see from it that if a voltameter with dilute sulphuric acid be charged with one Menotto's cell for a certain time, then dis-

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Read before the Royal Society, May 27.

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charged for a certain time, by removing the battery and connecting together the platinum plates of the voltameter through a resistance, and finally the platinum plates be insulated, that the difference of potentials between the plates gradually rises, presenting phenomena exactly like the soaking out of the residual charge in a Leyden jar that has been insulated after being discharged for a short time.

The unsatisfactory nature of the ordinary experiments with condensers has led us to try if we could find the actual constants in Professor Clerk Maxwell's differential equation—

$$\frac{d^n v}{d t^n} + a \frac{d^{n-1} v}{d t^{n-1}} + \ldots + m v = a' u + b' \frac{d u}{d t} + \ldots + m' \frac{d^{n-1} u}{d t^{n-1}} \quad (1),$$

where v is the difference of potentials of the two surfaces of the condenser, and u the current flowing into or from the condenser at the time t, for it is quite evident that if his theory be correct these constants completely determine the residual charge phenomena of the substance. The difficulty in obtaining these constants has involved us in a very large amount of labour, and we have only yet reduced a small number of the curves we have experimentally obtained during the last five years; in addition, we have found that many of our experiments will have to be repeated with somewbat different conditions for the investigation to be regarded as complete. But some of the results already obtained from this reduction are of interest; thus, in one set of observations, we have tried to determine the constants from curves of the soaking out of the residual charge of a Leyden jar discharged for a very short time, having been previously kept charged for so long a time in a room of nearly constant temperature that no loss was observed during two or three days—that is, the jar may be regarded as possessing almost infinite insulation.

The Leyden jar employed for these experiments was that of a Thomson's quadrant electrometer, and the measure of its charge was determined from the deflection produced in the needle of the electrometer itself when the electrodes of a Latimer Clark's constant cell attached to the electrometer quadrants were reversed. In reality three such cells in succession were used in order to detect any irregularity in the cells themselves. The Leyden jar was first rather highly charged, and then left with the replenisher untouched for some days until the loss of charge from day to day became imperceptible. The readings obtained with each of the three Clark cells were then accurately taken, when one of them being left on the electrometer electrodes the Leyden jar was discharged for a very short time and then insulated; the soaking out of the residual charge was now measured by taking time-readings of the increase of deflection produced by the constant cell. To allow for alteration of zero of the electrometer arising from alterations of its charge, frequent reversals of the cell were taken. After some minutes, the right and left readings due to the reversal of the cell could be observed on the ordinary scale placed two metres away from the electrometer; but at the commencement of the insulation after discharge, the soaking out was far too rapid to allow of numbers on the scale being read, consequently the following device was employed to allow of our obtaining the early part of the curve with accuracy. In the slit of the lamp were two cross-wires, an image of which, by means of the mirror in the electrometer and of an auxiliary lens, was formed on a cylinder 13 centims. in diameter and 100 centims. in length, revolved fairly rapidly by clockwork around a horizontal axis. The comparatively rapid motion of the image of the cross-wires was then accurately followed by an observer, who with a pencil dotted its position from time to time on a sheet of paper wrapped round the revolving cylinder. On unwrapping the paper the dots made by the pencil allowed the curve of rise of potential to be drawn accurately from the beginning in each case.

(TO BE CONTINUED.)

THE DYNAMO ELECTRIC MACHINE AND ITS APPLICATION AS THE MOTIVE POWER ON AN ELECTRIC RAILWAY.*

BY DR. WERNER SIEMENS.

After giving a short history of the development of the machine, the author comes to the special subject under consideration, cautiously mentioning that he does not propose that electricity should supersede steam as a motor on all railways; but, as in lighting by electricity or by gas, the two methods will find their own fields. When one dynamo machine is driven by another, the driven will generate a current in the opposite direction to that produced by the driving machine; from which consideration it is evident that the maximum power must be produced at a certain speed for the driven machine, and by the author's calculation for two *similar perfect* machines, this would be when the driven machine is running at one-third the speed of the other.. By a perfect dynamo machine is understood one in which the mass of iron is such, that the magnetic intensity is proportional to the current in the convolutions, and in such, when the current is closed in itself, the work is proportional to the third power of the velocity of rotation. In practice this is not so, due to the increase of the resistance of the brush contacts and the molecular resistance of the iron to magnetisation at the higher velocities. This being the velocity at which the maximum work is produced, does not mean that the efficiency of the machines is only one-third, but the power reproduced in useful work is proportional to the velocities of the two machines. From numbers of experiments recently made at moderate velocities, the useful work was 40 to 50 per cent. of the expended, and at higher velocities as much as 60 per cent. was obtained. It is, perhaps, merely a question of the size and velocities of the driving and driven machines, whether a still higher percentage of power may not be regained. Now comparing the useful effect obtained from large boilers and stationary condensing or compound engines, and that from the high-pressure locomotive engines, it is possible that the 50 per cent. of the dynamo-electric transmission may be as economical, seeing that there is little loss in originally producing the electricity. One advantage could certainly be obtained from the use of electricity on railways, as by its means a greater adhesion of the wheels on the rails could be effected, so that steeper inclines would be allowable, and tunnels consequently shortened or altogether omitted; and, on the other hand, resulting in a more powerful means of securing efficient brakes. Thus it would be desirable for mountain railroads, and those used for construction or mining operations. Other appropriate applications would be for small railways for transmission of postal messages, analogous to the pneumatic tube system, but available for longer distances than the latter, and for "elevated railways."

For postal service the author proposes a small covered railway track about 18 inches high, mounted on short iron columns, erected alongside existing railways, or by any other route, as the gradients could be adjusted by using columns of proportionate heights. Small drawings are inserted of the general plan of the details, the two rails being insulated from each other by being mounted on wooden sleepers, one being in connection with the sheet-iron covering, the other in connection with the earth by means of the iron supporting columns, to form the conductors for the current generated by the stationary machine, the circuit being established with the motor on the axle through the wheels by suitable commutators. The electrical resistance of such a system of conductors would not amount to more than 0·02 Siemens' unit per kilomètre, so that one stationary machine would suffice for a length of 20 kilomètres. If the stationary machine were of such a construction as to give a considerably more powerful current than the motors, the speed of a carriage would not be sensibly diminished if others were introduced on the rails at the same time; it being a property of the dynamo machine that the power increases at a greater ratio than the speed of rotation; as the motors could be designed to turn 800 or 1,000 times per minute, a speed of 1 kilomètre per minute with such a railway could easily be obtained. At the present high price of iron, the cost of such a line is estimated at 18,000 marks per kilomètre (say £900). For the "elevated railway," by a proper construction of girders and strong supporting columns, which would raise it sufficiently from the roadway to allow the maintenance of the traffic as usual, the resistance per kilomètre could be reduced to 0·011 Siemens' unit per kilomètre, so that a length of line sufficient for a circular railway in the largest towns could be worked by one stationary machine. The cost of such a line is estimated at about 150,000 marks per kilomètre (say £7,500), and a speed of 30 to 40 kilomètres per hour could be obtained. Of course any other arrangement of conductors might be applied, as, for instance, a central conducting wire supported between the rails on glass or furnace-slag carriers, which could be lifted by suitable rollers on the carriages, and thus establish electrical communication with the motors; or a central insulated fixed rail could be applied for the same purpose. An actual working line constructed on the last form was shown at the Berlin Exhibition, consisting of an electric locomotive drawing three cars, each constructed to carry six passengers; and here it was noticed how slight a variation in speed was caused if the cars were empty or doubly or trebly loaded with their complement of passengers. The author concludes by hoping that as Berlin was the birthplace of the dynamo-electric machine, in that town also may the first dynamo-electric railway be erected.

* Abstract from *Electrotechnische Zeitschrift*, vol. i., p. 47, in "Institution Civil Engineers' Abstracts," &c.

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DR. SIEMENS AT THE SOCIETY OF TELEGRAPH ENGINEERS.

The name of Siemens will take a very prominent position in the history of the scientific progress of the nineteenth century. The Siemens-Martin furnace is a household word among metallurgists, but to electricians the firm is one of the most eminent of those constructing telegraphic and electric light apparatus. There seems, indeed, as time rolls on, an increase of energy in divising apparatus, and experimenting to open up new fields. A proof of this, if one is needed, will be found in the admirable paper by Dr. Siemens, read last week before the Society of Telegraph Engineers. In this paper Dr. Siemens sketches three grand paths of research, the entrance to which has but recently been indicated. We have more than once stated that a grand future lay before the experimentalist who entered heartily and thoroughly into the domain of electro-chemistry, a subject which we think includes that of electro-metallurgy. Anyone who reads Faraday's work must be struck with the idea that the giant investigator had a strong *penchant* for electro-chemical work, and must acknowledge that since his time the subject has been strangely ignored. Undoubtedly, casual investigations have been made of great value, but mathematicians and not physicists have carried on the work commenced by Faraday. He worked with what we now look upon as rude instruments. The Gramme and the Siemens machine, the magnets and dynamo machines in the evolved state of perfection in which we see them now, were unknown to him, but we seem at the present time to have no one capable of wielding to any purpose these machines in electro-chemical researches.

Perhaps the paper of Dr. Siemens will give the necessary impetus, and direct the mind of some young, able, ardent, and persevering experimenter in this direction.

A casual remark made during the reading of the paper by Dr. Siemens deserves attention. He stated that it was not till he had carefully ascertained the theoretic correctness of his views that he attempted to prove them experimentally. This is exactly what so many neglect. They have not studied, they do not study "theory," but hope to make by assiduous labour some haphazard combination that will put into the shade all previous work in the same direction. Accidental combinations of this kind may occur, but the probability is that nothing of the kind happens, but that the results obtained are such as a person well versed in theory would describe in five minutes. We have heard and seen too much of the way "how not to do it," and earnestly hope that students will weigh the words of Dr. Siemens and find the right way of "how to do it."

The three fields of research alluded to by Dr. Siemens are electro-metallurgy (to which we have referred), electro-horticulture, and transmission of power. The horticultural results obtained are certainly somewhat startling. Hitherto it has been a tacitly-accepted doctrine that plants as well as animals require periods of rest, and that nature, by giving us night and day alternately, had given the best means of obtaining that rest. Dr. Siemens, however, arguing from the results already obtained, thinks that plants are better under the almost constant invigoration of the actinic rays of light. The fruit, indeed, is smaller, and the luxuriant growth of the plant curtailed; but, on the other hand, the flavour of the fruit is better and the plant stronger and more vigorous, added to which the fruit can be obtained a month or so earlier than by allowing nature to take its course. The author of the paper is preparing more extended experiments, among which will be one to test the value of the constituent light vibrations. Plants will be placed so that a particular portion of the spectrum can constantly for days, if not for weeks, fall upon them, and the results will be carefully compared. It is premature at the present time hoping to obtain any indication of the exact position the electric light will take with regard to horticulture, but we may be sure that many who have the means will gladly enter this field for experiment, whilst we can patiently await the results. This question is more a question for the few who have, so to speak, unlimited funds wherewith to gratify the appetite than to the masses who can never hope to purchase strawberries a month earlier because of the introduction of the electric light to assist in the quick development of the plant.

The application of electricity to railway work is, on the other hand, a question for the multitude. If we can devise any means to utilise the power produced by the oxidation of coal more economically than at present, it will be a decided advantage. No one expects electric motors to supersede steam engines at once, nor at the moment can one well see how to obtain greater economy by such substitution, but undoubtedly there is an opening for electric motors, and the progress of invention will render them more and more useful as time rolls on. The employment of such motors, even at a slightly increased cost, in such places as the St. Gothard tunnel, as proposed by Dr. Siemens, must commend itself to every one. He says: "In passing through an adit or tunnel, the entire freedom of smoke from the electric motor is a matter of great importance, and the administration of the St. Gothard tunnel contemplates seriously the application of an electro-motor for conveying trains through that gigantic tunnel." We might suggest the advisability of our own underground railway administrations considering the question. The purity of the atmosphere is worth attention, and it may be found advisable to spend money on obtaining it. Be that as it may, we again say that Dr. Siemens has pointed out that there is still plenty of work to do, that invention is not at an end, and, more, that investigation into the application of scientific laws may be made to pay.

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LIST OF BRITISH SUBMARINE CABLE COMPANIES: DECEMBER, 1879.

Compiled by LEWIS WELLS, F.S.S.

TITLES.	CAPITAL.				Cable Mileage.	Revenue.	Per-centage of dividend on ordinary capital.	Reserve Dec. 1879.	MARKET QUOTATIONS.	
	Ordinary.	Debentures.	Preference Stock or Shares.	Total.					Feb. 25, 1880.	May 13, 1880.
	£	£	£	£		£	£	£	£	£
Anglo-American	Ord. 2,669,380 / Def. 2,165,310	...	2,165,310	7,000,000	12,272	671,000	5	571,309	60	63
Brazilian Submarine	1,300,000	...	...	1,300,000	3,667	145,000	5	230,765	80	82½
Cuba Submarine	160,000	...	60,000	220,000	942	37,000	6	27,086	95	97½
Direct Spanish	116,379	...	58,430	174,809	781	13,000	Nil.	1,700	25	22½
Direct United States	1,213,900	100,000	...	1,313,900	2,983	207,900	5	150,000	57½	60
Eastern	3,697,000	882,000	700,000	5,279,000	16,325	500,000	5	230,000	90	90
Eastern & South African.	400,000	550,000	...	950,000	3,845	...	New company	...	10	10
Eastern Extension	1,997,500	897,600	...	2,895,100	9,773	290,000	5	157,870	90	90
German Union Trust	193,500	...	...	198,500	224	12,858	5⅞	22,983	90	90
Great Northern	1,500,000	...	...	1,500,000	4,297	204,000	6⅜	125,000	95	97½
Mediterranean Extension .	120,000	...	32,000	152,000	204	11,000	3	11,307	30	30
Montevidean & Brazilian ..	6,000	14,380	83,140	103,520	200	3,000	1¼	1,750	25	25
Platino-Brasileira	381,480	100,000	...	481,480	1,058	19,000	1¾	4,863	55	55
Submarine	338,225	...	...	338,225	609	120,000	18	75,781	230	240
West India and Panama ..	883,210	14,200	392,320	1,289,730	4,068	75,000	Nil.	30,489	20	20
Western and Brazilian ...	1,398,200	302,990	...	1,701,190	2,517	92,700	Nil.	Nil.	40	37½
West Coast of America ...	300,000	...	147,100	447,100	1,690	26,000	Nil.	5,000	30	20
			Total ...	£25,344,554				£1,645,903		

CORRESPONDENCE.

CARBONS AND DIFFUSION APPARATUSES FOR ELECTRIC LIGHT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Under the above heading, in your issue of last week, you invited discussion on the manufacture of carbons, and incidentally on the diffusion of the electric light. I have had a good deal of experience with the former, and I have given many serious thoughts to the latter subject; therefore, with your permission, I propose to start the desired discussion, hoping that the remarks I may have to make will not be found unworthy of your columns, and will be instrumental in bringing forward the ventilation of these two important points in electric lighting.

Let me premise by saying that I quite agree with your remark that the several washings of the raw material destined to the manufacture of carbon electrodes in, alternately, weak acid and alkaline solutions is but delusive. No amount of boiling in these solutions will remove much of the impurities. The largest percentage of the impurities contained in coke is so thoroughly diffused through the mass, in fact, so combined with it, that nothing short of incineration can remove them. No doubt, boiling and washing in such solutions may rid the coke of extraneous matters; but a simple, though careful, selection of the raw material will do quite as much. Besides coke, many other substances may, if properly treated, yield pure carbon. To find pure raw carbon is comparatively easy; it is different with the treatments it must be subjected to to be turned into a compact and homogeneous electrode. The difficulties in the way of the production of an irreproachable carbon rod for electric lighting are of a chemical but by far more of a mechanical nature. Let me say in passing that the many inventors of new electric lamps are rather too unanimous in blaming the carbon points for defects of the light they produce by their pet systems. Many of them look upon a carbon electrode as a very simple thing to make, and as to its cost, well, it is simply composed of coke, and the maker needs be but a simpleton. Perhaps a better knowledge of the subject will change opinions too easily formed.

I say, then, that the difficulties are both chemical and mechanical, and to better illustrate what would be the result if the desideratum carbon electrode could be made, let me suppose, for an instant, that carbon is fusible, and also soluble in a liquid of some kind; the carbon then would have only to be fused and moulded like cast iron, or to be dissolved and allowed to crystallise; in both instances a perfectly homogeneous, compact, and pure carbon electrode would be the result, but, perhaps, greater perfection would be with crystallisable rather than with the fusible carbon. The atoms of the carbon would conglomerate together, and the molecules thus produced would adapt their forms to that of their immediate neighbours in course of formation at the same time.

But, unfortunately, carbon is neither fusible nor soluble, and to make with it a homogeneous and compact electrode the manufacturer has to trust to mechanical appliances more or less perfect for powdering the raw material, for mixing the powder with an alien body, and, finally, for pressing the whole into the required shapes and sizes; and even then, if he has surmounted these operations well, he is only halfway towards the finish, as he has to expel the whole or part of the alien material he has employed for making his paste, and the result is he disturbs the compactness of his rod, and he has to reconstruct it.

There is not the slightest doubt that, however well the raw coke or retort carbon may appear to be powdered, it is never in such a degree of fineness and uniformity as to produce an agglomerate equal in compactness to that which would be produced were the raw material soluble or fusible.

A microscopic examination of the finest powder will show particles of all sizes and forms, and it is perfectly impossible to bring these particles together so closely and completely as to form a mass without flaws or vacuums, however small these may be.

I have tried many mills, and I have not found one yet to produce a powder equal say to lampblack, or chemically powdered plumbago; the only mill that I have found coming closely to the desideratum is that known as Milburn's conical.

So long, therefore, as crushing mills will not be found to pro-

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duce a powder of uniform impalpability, so long there will be unavoidable flaws in the carbon electrodes made by agglomeration entirely or principally.

Of necessity the paste for the manufacture of carbon rods, as at present composed, is made with the help of some materials which upon heating leave nothing behind but carbon, and which glutinise all round the particles of the powdered carbon, and make them stick together under pressure.

A good kneading apparatus is still needed to perform this operation satisfactorily. The more the paste is kneaded with the proper instrument, the more compact it becomes; but where to find the instrument? The best I know is the mortar and pestle. However, I suppose the paste is well kneaded and perfectly homogeneous, it now requires to be moulded, and for that operation presses with hydraulic or steam piston are employed; the carbon mass is placed into a cylinder fitting the piston and forced to pass through the moulds or openings of the required sizes and forms.

For reasons hereafter shown, I do not consider that great pressure is of any advantage; beyond mere moulding it can go very little towards the manufacture of a homogeneous and dense rod. The mass, as I said is placed into a cylinder with a discharge opening at one end; the power of the piston is applied and the rod comes out; the quicker the piston travels, the quicker comes out moulded paste; and if theoretically the pressure given by the piston is according to its speed, practically the effect is almost destroyed by the corresponding greater speed at which the carbon rod also travels.

Whatever effect pressure may have, it is evident that alone it could only produce a relatively perfect electrode if it compressed together the uniformly impalpable powder yet to be found without the help of any extraneous matters. Almost as soon as out of the mould, the pasty carbon electrode begins to lose in weight through evaporation in drying and further loses more by baking. In the case of Carré, for example, the loss is between 15 and 25 per cent. after the first baking, and this loss must be made good by repeated soaking and rebaking before the electrode can be said to possess some degree of compactness.

At this point, that is, when the carbon rod is firm and can bear handling, lies the opening for improvement. The refilling of the pores created by baking the rods must be arrived at with the same quality of carbon the stick is made of. The method adopted by Mr. Jaquelin in making his carbon is certainly sound in theory if extravagant in practice. If I deduct rightly from some experiments I have been making on the basis of the same theory, I think it can be modified so as to meet the requirements of a commercial undertaking.

I might take too much of your valuable space if I were, after having given you a general review of the case, in the same letter to indicate what possible sources of carbon better than that now used might easily be found; and also to go into the subject of reflection and diffusion of the electric light by totally new means and plans novel. If you allow me, I shall continue the subject next week.—Yours, &c.,

A. VASSARD.

Late Expert Chemist to the Board of Trade, Member of Society of Telegraph Engineers, &c.

16, Annandale-road, East Greenwich, June 7.

STUDENTS' COLUMNS.

ELECTRICAL PARADOXES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR,—In almost every examination paper on electricity and magnetism, we meet with a question of a nature rather puzzling to those unacquainted with the various "catches" set by examiners, more to test the alertness and sharpness of the student than his electrical knowledge. Even students who answer the most difficult and complex questions, are sometimes caught by a paradox, in trying to give an elaborate explanation for a simple fact.

I shall endeavour in the following paper to give some of the most frequently practised "catches," so as to place students on their guard, and I have no doubt prevent a good deal of exasperation on their part.

An exceedingly simple "catch" is sometimes laid on the heating of wires, and a question of this nature was given a short time ago, and "caught" several of the competitors.

This was the question—

If a current of 1 Weber per second will heat an inch of a given copper wire, what current would heat a yard of the same wire to the same degree? The answer is:—A current of one Weber per second.

Questions of this kind have often puzzled students, although it is a most simple fact that a current capable of heating an inch must also be capable of heating a yard to the same degree.

Another question which ought to be almost as simple as the preceding one, at least to students engaged in the study of the science of electricity is—if we have a large battery placed in opposition to one of the same kind made up in a nutshell, will one overpower the other? and, if so, which is the stronger? The answer is that they exactly balance each other.

A curious and amusing paradox was once practised by a lecturer on his pupils.

After connecting wires to the terminals of a Daniell battery, he informed his pupils that if the current actually passing were to traverse their bodies the results would be very disagreeable. He then asked if there were any candidates ready to test the truth of this.

Some sagaciously shook their heads, but others tried the experiment, which, of course, owing to the immense resistance offered by their bodies, was perfectly harmless.

Questions sometimes asked by pupils during a class or lecture, which are apparently at first sight highly ludicrous, often show, when brought into consideration, that the questioner has grasped the subject more widely than others.

An instance of this once occurred in a young student having asked, during the explanation of Ampère's rule on the direction of a magnetic needle, whether the person who is described as lying on the wire, reclined on his stomach or on his back? he seeing that the change in position must necessarily change the man's right and left, which he may have first noticed in "Ferguson's Electricity," in which it says, "The supposed figure has to look down to the needle, when in the upper wire, and to look up to it in the lower wire, so that his left hand is turned in two different ways in the two positions." The above-mentioned paradoxes, I hope, will be of use to students, who, if able, I hope will add others.—I am, &c.,

MARMADUKE CLARK.

QUADRUPLEX TELEGRAPHY.

Quadruplex telegraphy is the system of telegraphy which enables four messages to be sent simultaneously by one wire, two in one direction and two in the opposite direction. At each end of the wire there are four instruments, two for sending and two for receiving; the sending instruments are called "transmitters" and the receiving instruments "relays."

DESCRIPTION OF THE APPARATUS.—In Fig. 1. T^1 is a "transmitter," which reverses the direction of the current flowing through the line. It is worked by means of the key K. When the apparatus is in its normal position, as shown in the figure, a zinc current goes to line from the battery E through the spring s^2 and the contact piece a, the copper pole of the battery being connected to earth through s^1 and t. When the key K is depressed and the local circuit of e_1 thereby completed, the lever t, which is in connection with earth, is brought into contact with the spring s^2, lifts it away from a, and is disconnected from s^1, which immediately comes into contact with a, thus; (Fig. 2). The result is that the current is reversed, and a copper current now flows to line. This transmitter, then, operates by *reversing* the current, and is worked by a key, K, omitted from the large diagram.

The second transmitter, T^2, in Fig. 3, operates by increasing the strength of the currents, and is likewise worked by a key, K, also omitted from the large diagram. It is known as Stearn's duplex transmitter. The line is shown to earth through B and D; but when the armature a is attracted by the closing of the local circuit contact between B and D is broken at b, while at the same moment contact between A and B is made, and positive currents are sent to line.

The large diagram shows the manner in which the two transmitters combine their action. E and 3 E are the line batteries, the one having three times as many cells as the other. The zinc z^1 of E is connected to S^2 of T^1, and the copper c of 3 E to A. The zinc of 3 E and copper of E pass through a resistance, Y, (which is the same as the resistance of 3 E) to lever D of T^2. When everything is quiet, the zinc of E is connected to line through s^2 and* a^1 of T^1, and the copper of E to earth through D, b, B, s^1, and t of T^1, whilst the copper of 3 E is insulated at A. Thus a current of normal strength flows from E to line.

When T^1 alone is worked, the current of E is simply reversed. When T^2 is worked alone, s^1, which is in connection with earth, is transferred, by means of B of T^2, from D to A, or, in other words, from c^1 to c; the strength of the line current is, there-

* The contact point a in Fig. 1 is here shown as two points a and a^1.

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fore, increased from E to 4E. When T^1 and T^2 are worked together, z^1 is put to earth through t, and c to line through A and B of T^2 and s^1 and a of T^1; and a reversed current of 4E is sent.

R^1 is an ordinary relay of Siemens' pattern, wound differentially, and so connected up as to respond to the working of the double-current transmitter T^1.

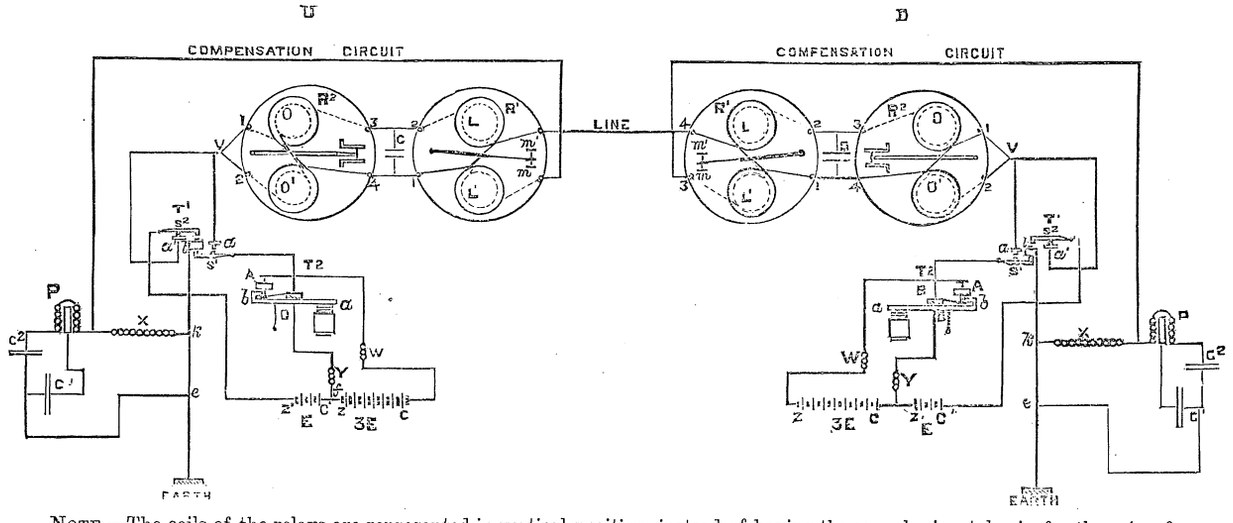
R^2 is a compound relay, which responds only to an increase in the strength of the currents, whatever their direction, and is worked by T^2. The tongue r is placed directly in the field of the electro-magnet operating it (Fig. 4.) It is so adjusted by means of the springs n and n^1 acting through the crank levers N and N^1 that it is not affected by the weak reverse currents sent by T^1. The local circuit, therefore, remains unbroken until the line current is strong enough to deflect the tongue; and when this happens the armature of S (a non-polarised relay) is released, and the circuit of S^2 (the receiving instrument) is completed. If, now, the line current is suddenly reversed, and the tongue r moves from one side to the other, the local circuit of S is momentarily completed; but the tongue moves so rapidly that the electro-magnet of S has not time to become magnetised.

C, C^1, and C^2 are condensers, to compensate the static discharge from the line. P is a rheostat used in connection with them. X is a rheostat used to balance the resistance of the line.

DESCRIPTION OF WORKING.—The large diagram illustrates the manner in which the apparatus is joined up for quadruplex working. U represents the "up," and D the "down" station. At each end are the two transmitters, one of which (T^1) reverses the current, while the other (T^2) increases it; and at each end are the two relays, one (R^1) responding to the reversal of the current, and the other (R^2) responding only to its increase. For the sake of simplicity the local circuits which bring the transmitters into action, and those which are brought into action by the relays, have been omitted from the diagram. It should, however, be borne in mind that the relays, R^1 and R^2, operate, the former by completing, and the latter by breaking, their respective local circuits. The former records a mark when its tongue presses against the contact point m^1; but when the tongue moves over to the insulating stop m the local circuit is broken, and no mark is recorded. In R^2, on the other hand, a mark is recorded when either pole of the relay, no matter which, attracts the tongue.

Let us look for a moment at the relay R^1, at U, the up station. The coils L and L^1 contain iron cores, convertible by the currents into magnets. The uppermost pole of each core is the pole that acts upon the tongue of the relay; and each of these uppermost poles becomes, now a south, now a north pole, according to the direction of the current; a south pole if the current goes round the coils in the direction of the hands of a watch, and a north pole if in the opposite direction.

That portion of the tongue which is acted on by the cores of the relay is a south pole, the tongue being a complete magnet. In order, therefore, that the tongue may press against the stop m^1, and complete the local circuit, it is necessary that the current should flow through the coils in such a direction as to render the core L a north pole, and the core L^1 a south pole. This can be brought about by a current passing through either the line or the compensation circuit. If by the line current it must enter at 4 and make its exit at 1; and if by the compensation current, it must enter at 2 and make its exit at 3. Reverse the direction of the current in either case, and the tongue will pass over to the insulating stop.



NOTE.—The coils of the relays are represented in vertical position, instead of having the same horizontal axis, for the sake of illustration.

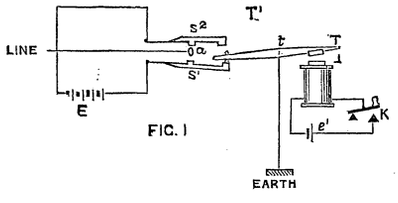


FIG. 1

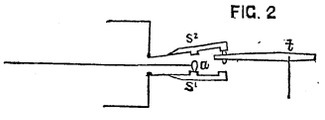


FIG. 2

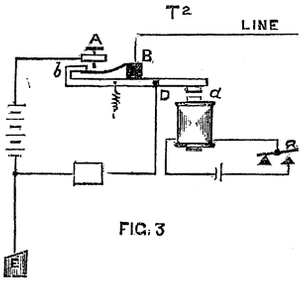


FIG. 3

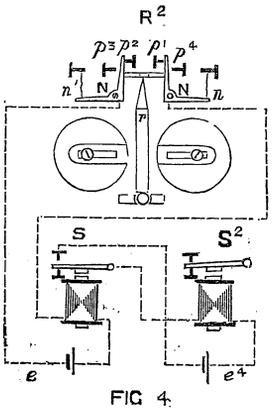


FIG. 4.

The action of the corresponding relay R^1 at D, the down station, is precisely similar. To complete the local circuit, the line current must enter at 1 and go out at 4; and the compensation current must enter at 3 and go out at 2.

We are now in a position to follow out the course taken by the currents through the system when the various keys are depressed.

It is postulated that the current passes from the copper pole of a battery, round the circuit, and so to the zinc pole.

Let U^{1*} be the key reversing the current } at the "up" station.
" U^2 " increasing "
" D^1 " reversing " } at the "down" station.
" D^2 " increasing "

As there are two keys at each end, and each key may be either raised or depressed, it follows by the rule of combinations that

* U^1 is short for T^1 of U, and so on.

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the circuit may be varied in sixteen different ways. The following is a list of all the variations of which the circuit is capable:—

1. All the keys in their normal position.
2 to 5. One key only depressed.
6 and 7. Two keys depressed at the same end.
8. U^2 and D^2 depressed.
9. U^1 and D^1 depressed.
10 and 11. U^1 D^2, or U^2 and D^1 depressed.
12 and 13. U^1 D^1 and D^2, or D^1 U^1 and U^2 depressed.
14 and 15. U^2 D^1 and D^2, or D^2 U^1 and U^2 depressed.
16. All the keys depressed.

1. When the keys are all in their normal position, the transmitters which increase the current (D^2 and U^2) are thrown out of circuit together with their respective batteries. Not so the reversing transmitters and the smaller batteries. From these a current flows by the following route:—Starting from C^1 in the up station battery, and passing, first through the resistance coil Y, and then through the transmitter T^2 by a short cut (D, *b*, B), it arrives at T^1 and traverses s^1 and *t*. When it reaches *k* it splits into two equal portions, one of which enters the compensation circuit through the rheostat X, and the other goes to earth. The latter portion, entering the earth wire at the down station (D), proceeds *viâ e*, *t*, s^1, B, D, and Y, to *f*. It then passes through the small battery and on through s^2, a^1, and V, into R^2. Here, entering at 1, it travels round O^2 to the right and O^1 to the left, and goes out at 4; enters R^1 at 1 and leaves at 4. It thus makes L^1 a north pole, and keeps the local circuit broken. Passing by the line wire to the up station (U) it makes L of R^1 a south pole, and L^1 a north pole, and going out through 1, traverses R^2, and returns to the battery *viâ* V, *a*, and s^2.

Meanwhile, the "U station" compensation current, which we left at *k*, goes through the resistance X to R^1. It enters this relay by 3 and leaves at 2, thus tending to convert L into a north pole. Entering R^2 at 3 it returns to the battery by the same route as the line current.

All this time we have ignored the current proceeding from the D station battery. From the battery to R^2 it follows the same track as the line current from U. Here it divides into equal portions, one of which continues in identically the same path as U's line current. The other leaves R^2 at 3, enters R^1 at 2, and leaves it at 3, and then makes its way back to the battery *viâ* X, s^1, B, and Y. Its effect is to make L a north pole.

It is clear that the currents which proceed from each station have no effect upon the relays belonging to that station, but are exactly neutralised in the coils. If, however, we take into account all the currents at the same time, we see that the total line current is twice as strong as either of the two compensation currents. It therefore tends to move the tongues of R^1 and R^2 at each station with a force equivalent to that produced by a current equal to the difference between the two currents. This force is not sufficiently great to make the tongues of R^2 move. The tongues of R^1 are, however, affected. They move, but owing to the direction of the line current, which converts L^1 in each case into a north pole, they merely move to the insulating stop at each station. It follows that no marks are recorded by any of the instruments.

2 to 16. The operation of the transmitters which increase the current (T^2), and the effect which they produce upon their corresponding relays (R^2), will be alluded to further on. With respect to the reversing transmitters it is only necessary to show that if either, or both, be depressed, the direction of the current through the coils in the corresponding relays will be such as to cause the tongues to be attracted to the contact points which complete the local circuits.

First, let the U station operator depress the key which actuates T^1. The U station current is reversed, both in the line and the compensation circuit. It follows that the two line currents from U and D respectively are now flowing in opposite directions. They are, therefore, simply neutralised, and their effect upon the entire system is *nil*. But the line current being, as it were, annihilated, the field is clear for the compensation current at each end to come into play. The U station compensation current, entering at 2 of R^2, and leaving at 4 of R^1, makes L^1 a north pole, and keeps the tongue of R^1 against the insulating stop. But the D station current, continuing to flow in the same direction as when the apparatus is at rest, as above described, now makes L a north pole, and no longer being counteracted by the line current, draws over the tongue of R^1 to the contact point m^1, and a mark is recorded.

Now, let D depress the key of T^1, the corresponding key at U being released. The effect is precisely similar. The line current is neutralised. The compensation current at D keeps the tongue of R^1 insulated; while that at U causes the tongue to press against m^1.

Lastly, let D and U both depress the keys of their reversing transmitters. The line current has now, as it had when the apparatus was at rest, double the strength of the compensation current, and overpowers it at each end. But its direction is not now the same; for it enters the up station relay R^1 at 1, and the down station corresponding relay at 4, in each case making L a north pole. At each end, therefore, the local circuit is completed, and at each end a mark is recorded.

A few words are necessary regarding the effect produced by depressing the key of T^2 (at either station), and thus quadrupling the number of cells in the battery. When the apparatus is at rest, the line current, as shown above, actuates R^1 at each end in such a manner that no marks are recorded; when T^1 is depressed at each end it actuates them in such a manner that a mark is recorded it each end. The effect depends in each case on the direction of the current. The important point to notice is, that so long as the direction of the current remains the same, its strength may be increased to any extent without producing any effect upon the tongues of the R^1 relays except to make them cling more tightly to the stop against which they were already pressing.

Let E consist of 20 cells, and 3 E of 60 cells. The keys of T^1 and T^2 at U are depressed, those at D remaining untouched. A current of 80 cells flows from U's battery and splits at V, a current of 40 cells going to line. A current of 20 cells is flowing in the opposite direction from D's battery, of which only half flows to line. This neutralizes the force of 10 of U's cells, and the total line current therefore equals that from 30 cells. This current has for its function to deflect the tongue of R^2. But it is flowing in the same direction as D's compensation current, by which a force of 10 cells is added. The total current, therefore, available for deflecting R^2 is one half of the whole battery at E, or 30 cells.

Now, when the apparatus is at rest the total current acting on R^1 and R^2 is 10 cells.

It follows that R^2 should be so adjusted that the tongue remains fast under a current of 10 cells, and is deflected by a current from 30 cells; and R^1 should be adjusted to respond to a current of 10 cells at least.

THE SOCIETY OF TELEGRAPH ENGINEERS.

THURSDAY, JUNE 3, 1880.

THE DYNAMO-ELECTRIC CURRENT IN ITS APPLICATION TO METALLURGY, TO HORTICULTURE, AND TO THE TRANSMISSION OF POWER.

BY DR. C. W. SIEMENS, D.C.L., LL.D., F.R.S.

Dr. Siemens commenced by referring to his inaugural address in 1878, in which he called attention to the use of electricity in transmitting power and in electro-metallurgy. He then proceeded to describe three somewhat novel applications of the dynamo-electric machine, viz., as a means of effecting the fusion of refractory materials in considerable quantities in an electric furnace; in certain effects in horticulture; and as a means of mechanical propulsion.

The paper was rendered the more interesting as experimental results were shown, as well as described and illustrated by diagrams.

Dr. Siemens showed that the electric arc is not only capable of producing very intense degrees of heat in a focus or extremely contracted space, but also such larger effects of intense heat, with moderate expenditure of energy, as will render it useful for effecting the fusion of platinum, iridium, steel, or iron, or for such reactions or decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from disturbing influences such as are inseparable from a furnace worked by the combustion of carbonaceous material.

Dr. Siemens exhibited his furnace, and demonstrated its utility by melting steel. The apparatus employed to effect this electro-fusion consisted of an ordinary crucible of plumbago, placed in a metallic casing, the intervening space being filled up with some bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of the conductor connected to the positive pole. The cover of the crucible is also pierced to receive the negative pole. The negative pole is connected by a strip of copper to one end of the beam of a balance, the other end being attached to a hollow cylinder of iron, free to move vertically within a solenoid coil of wire. By means of a sliding weight the balance can be adjusted, to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. The variation in the resistance of the arc is counteracted by the action of the solenoid. This automatic adjustment of the arc is of great importance to the attainment of advantageous results in the process of electric fusion. Without it the resistance of the arc would rapidly diminish, and heat would be developed in the dynamo-

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machine to the prejudice of the furnace. The sudden sinking or change in electrical resistance of the material undergoing fusion would, on the other hand, cause sudden increase in the resistance of the arc, with a probability of its extinction, if the automatic action were wanting. It is important that the material to be fused should constitute the positive pole of the battery. Here heat is principally developed, and fusion takes place before the crucible itself is heated to so high a temperature. Dr. Siemens gave some interesting quantitative explanations. He said the dynamo-electric machine, consuming 4·25 horse-power, or 3·17 ergtens per second, will send a current of 40·5 webers through 1 unit electrical resistance; replacing the resistance by an arc maintained by the balance-weight constantly at 37·8 volts electromotive force, the same current will flow.

Neglecting the connecting wires, there will be developed in the arc an energy of

$$1{,}531{\cdot}2 \times 10^7 \text{ ergs. per second} =$$
$$9{,}187{\cdot}2 \times 10^8 \text{ ergs. per minute} =$$
$$1{,}378{\cdot}1 \times 10^{10} \text{ ergs. per 15 minutes} =$$
$$32{\cdot}8 + 10^4 \text{ gram water degree units of heat.}$$

Assuming steel to have the same specific heat as iron, viz., at $t^0 =$

$$\cdot 1040 \times 0{\cdot}000144\, t,$$

and that the melting point of steel is 1800° C., then 420·5 units of heat will be expended in raising the steel to this temperature; and assuming the latent heat of fusion at 29·5 units (silver is 21, and zinc 28), there are roughly 450 units required to melt a gram of steel, and 225,000 to melt half a kilogram, that is about $\frac{2}{3}$ of the heat generated in the crucible, and $\frac{1}{3}$ of the horse-power actually expended. A good expansive condensing steam engine converts the heat energy residing in coal into mechanical energy, with a loss of about eighty per cent., or, in other words, $\frac{1}{5}$ only of the 7,000 units residing in a gram of ordinary coal is represented as work in the engine. The useful effect attainable in the electric furnace is therefore $\frac{1}{3} \times \frac{1}{5} = \frac{1}{15}$ of the heat energy residing in the fuel consumed under the boiler of the engine.

To melt a gram of steel in the electric furnace takes, therefore, $450 + 15 = 6{,}750$ units, which is within a fraction the heat energy residing within a gram of ordinary coal. It results from this calculation that, by means of the dynamo-electric machine worked by a steam engine, one pound of coal is capable of melting one pound of mild steel. In melting steel in the ordinary air furnace, as practised at Sheffield, three tons of best Durham coke are consumed; to melt a ton of mild steel in crucibles, and in working with the regenerative gas furnace, one ton of coal effects the fusion of one ton of steel in crucibles, whilst to produce steel in large masses on the open hearth of this furnace, 12 cwts. of coal suffice to produce one ton of steel. The electric furnace may be therefore considered as being more economical than the ordinary air furnace, and would, barring some incidental losses not included in the calculation, be as regards economy of fuel nearly equal to the regenerative gas furnace. It has, however, the following advantages in its favour:—1st. That the degree of temperature attainable is theoretically unlimited. 2nd. That fusion is effected in a perfectly neutral atmosphere. 3rd. That the operation can be carried on in a laboratory without much preparation, and under the eye of the operator. 4th. That the limit of heat practically attainable with the use of ordinary refractory materials is very high, because the fusing material is at a higher temperature in the electric furnace than the crucible, whereas in ordinary fusion the temperature of the crucible exceeds that of the material fused within it. Without wishing to pretend that the electric furnace here represented is in a condition to supersede other furnaces for ordinary purposes, the advantages above indicated will make it a useful agent, I believe, for carrying on chemical reactions of various kinds at temperatures and under conditions which it has hitherto been impossible to secure.

(TO BE CONTINUED.)

THE BATTLE OF THE SET-SCREW.

The sharp rivalry of American telegraph companies is exhibiting itself in an unprecedented degree just now; and one of the most striking incidents of the struggle is the litigation now going on about a set screw in the Morse instrument. The screw in question is placed on the instrument to regulate the play of the armature of the electro-magnet, and though it is a small matter in itself it has been made the ground of an injunction brought by the Western Union Telegraph Company against the American Union Telegraph Company, the Wabash, St. Louis, and Pacific Railway Company, and the Union Pacific Railway Company, restraining the latter from using the Morse apparatus without paying the Western Union Company a royalty or licence.

The authority of the Western Union Company for taking such a course lies in the fact that the said regulating device was first patented by Mr. Page, the well-known inventor of the tonic electro-magnet, which is the germ of the electro-magnetic telephone, and is claimed in the 13th clause of that patent. Page being an examiner of patents for the United States Government, was not allowed to take out patents for ideas himself, until his connection with the Patent Office ceased, when the Government granted him a special patent. This patent is owned by the Western Union Company, and hence the action.

The case was recently tried before Judge Blatchford, and the associated defendants prayed that the decision should be so modified as to exempt them from payment of the royalty demanded, on the ground that they have always used the machine and devices patented by Professor Morse, and that it could be proved that the original Morse instrument on exhibition in the office of the Western Union Telegraph Company was made by Professor Morse as early as 1835, and contained all the essential parts of the device described in Page's patent. They also claim to be able to prove that Mr. Thomas Hall, of Boston, manufactured a machine under the Morse patent containing the set screw of Page, and that Mr. Page wrote to the Hon. Amos Kendall in 1848 to the effect that he had never claimed the invention of the receiving magnet used in the Morse telegraph. The answer of the Western Union Company to this plea was the production of their original Morse instrument in court, when no trace of the set screw could be seen; and the defendants thereupon insinuated that the screw had been removed.

According to the latest information, the case is not yet settled, but the new self-adjusting relay magnet, which we announced in our last number, will enable the American Union Company, at least, to dispense with the disputed screw altogether. This is a result which might have been anticipated in a country of inventors like the United States, where if one door is closed another is soon prised open.

The decision of Judge Blatchford was given on May 7, when, after reviewing the facts and evidence presented, he refused to grant the petition of the defendant companies to be exempted from payment of a royalty to the Western Union Company. An affidavit by Mr. G. B. Prescott, electrician of the company, is worthy of quotation from its historical value. He says, "Professor Morse examined the claims of the Page patent [contained in the 11th, 12th, and 13th clauses], and said that he did not know any one other than Professor Page who had invented the things claimed in that patent; he did not invent them himself, and had never claimed to have invented them. He said his claim was for the combination of the various devices which enter into his apparatus, and that he did not invent the elementary parts which were essential to the success of the combination." Mr. Prescott then described in detail the original wooden experimental apparatus made by Professor Morse in 1835 or 1836, in which there is no adjustable set-screw or adjustable retractile spring, which are the matters in controversy in this suit.

The above decision, however, only applies to short circuits, and it remains to be tried whether any of the companies would be liable to pay a royalty for using the apparatus on long or main circuits. This is another of the mysterious refinements of American patent law which have been disclosed by this remarkable litigation.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).

The third ordinary general meeting of the Company (adjourned from the 23rd April) was held on Friday, the 4th inst., at the Cannon-street Hotel, under the presidency of Mr. A. R. Johnston.

The secretary (Mr. Fred. L. Robinson) having read the notice convening the meeting,

The CHAIRMAN expressed his regret that the final accounts from the stations on the West Coast had not yet been received. They had had a few lines from their general manager at Lima, in which he mentioned that he had forwarded a mail overland which had not then come to hand, but it was not stated whether the accounts had also been sent. They knew that there had been great difficulty in getting the accounts together from the disturbed state of the coast. Very little had happened since their meeting six weeks ago, but he regretted to say that so far as their earnings were concerned matters had not improved in the interval. The war continued to drag along; Mollendo had been entered, and had been more or less destroyed by the Chilian forces, and the Company had thus suffered pretty severely. He did not know that it was anything very great as regarded money, but their property had been destroyed. Part of the instruments, however, had been saved, which would enable them to continue working when they had the opportunity. They were in imminent danger of being driven out of Callao, in which case they would retire on Lima. They were waiting till matters became more settled. As regarded their earnings, he informed them six weeks ago that they were looking better. In January the receipts were an improvement on those of December, and February and March had a further increase, but that seemed to be the turning-point. In April the receipts went back materially, and May was also disappointing, but that was approximate only. Communication had been so dis-

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turbed that business could not pass over the lines. From Valparaiso to Iquique there was still communication going on, and the probability was that the statement of the earnings which they received now was confined to that, and there might be something more from the northern stations. They, of course, much regretted that they were in their present condition, but it was owing to circumstances entirely beyond their control; and so soon as they received the accounts and could place them before the shareholders they would call them together again, and he trusted he would then be able to give them more favourable hopes for the future.

Mr. ROBINSON KENDAL said he had been informed "outside" that the accounts were sent over two or three mails ago, that they had been lost, and that as a copy of them had not been kept on the other side they could not be sent forward.

The CHAIRMAN said that was the first they had heard of it. They did not know whether that was the case or not, but they had not heard of it, and they had no reason for believing that the accounts had been forwarded. The last note was dated the 14th April, and no mention was made about the accounts.

Mr. KENDAL desired to know how the accounts were kept. Were they kept on the West Coast from one year to another, or were they sent forward monthly?

The CHAIRMAN: Monthly.

Mr. KENDAL asked up to the end of what month the directors had received the accounts, and how matters then stood?

The CHAIRMAN replied that they had received the accounts up to the end of November. They were therefore only short of the accounts for December.

Mr. KENDAL thought it would be to the interests of the shareholders that they should receive an approximate statement of the position of affairs.

The CHAIRMAN said he gave the information required at their first meeting to the best of his ability. He then stated that they were not in possession of closed accounts. They could not get the auditors to close the accounts, but he would give them the information so far as he could.

Mr. D. H. SMALL thought it would be better to call another meeting when the accounts were completed. He saw no use in going over the accounts again.

A SHAREHOLDER said he did not attend the late meeting, as the announcement said it would be held only *pro forma*.

The CHAIRMAN said he went into some detail at the last meeting. The earnings for the eleven months ending last November amounted to £20,050, in round figures. As he had stated, the December traffic was not to hand, but they might put it at £1,000. It was a doubtful item, but probably that would be the amount—a little more or less. The debenture interest was £12,000, the working expenses along the West Coast of America, at all the stations, and in London amounted to £9,000—he was not giving the exact figures, but as near as possible—and the balance to the debit of the repairing vessel, the Retriever, was £5,300. Altogether that came to £26,300, and if they took from that £21,300, the approximate receipts, there was £5,000 against them. They had a claim on the Chilian Government for loss of traffic, the cutting of their cables, and for the very serious damage which they had received during the course of the war; and that claim, which was a heavy one, they hoped in due time to recover. It had not till lately been so closely pressed as it was now, because they had been given to understand that if it were not pressed it would be more favourably received at the close of the war. They, therefore, assented to its not being pressed in the hope that the war would come to a close very much sooner. The war, however, had been going on for about a year, and they had consequently been urging their chief manager to press the matter. They hoped and trusted that if they did not receive their claim in full they would in the meantime have some portion of it on account to help them. The long continuance of the war was a very serious matter to them. Practically they had a deficiency of £5,000 on the year's working. The debenture interest must be paid. They were in hopes of being able to renew the favourable arrangement they made before for the payment of the debenture interest. The next debenture interest would fall due at the end of the month. They were doing all they could in the interest of the Company in the difficult circumstances in which they were placed. Replying to further questions, the chairman stated that the vessel was built primarily for repairing their cables; but as they knew that it would be a very serious outgoing for a company such as theirs should she earn nothing when she was unoccupied—because she might be unoccupied a very long time—they had her fitted to carry water from port to port, which was very profitable work in ordinary circumstances. She was also fitted with machinery for raising sunken vessels, and adapted for towage, &c. They did everything they could on this side to make her profitable on the other. Before the war broke out they were on the point of concluding what appeared a very favourable arrangement for carrying water. On one occasion she had an opportunity of showing her powers in raising a vessel, which she did very successfully. That had been her principal work this year, and she had earned in that manner £1,650. She had also been engaged in towage, and was quite fit for that work. There was little or no work to be got on the coast at present. She had been kept going as far as possible in carrying coal and metals, but the return had been only little better than letting her lie idle. There was no doubt that when the war closed they would be able to employ her advantageously. She had done them very great service in connection with their cables, for which they did not charge. She was specially built for the Company, with the greatest care. The Chilian Government had verbally acknowledged their liability to the Company.

Mr. GREY, in answer to Mr. John Taylor, who thought it would be more advantageous to the Company to hire a vessel whenever they required to make any repairs to their cables, said it was necessary, in the opinion of the Board, to have a properly equipped vessel, so as to repair the cables with the least possible amount of damage to existing cables, and it was necessary to have trained men out there ready for the purpose. The Company was not to be called a small one, seeing that they had about 1,700 miles of cable.

Some discussion took place on a motion for the appointment as a director of Mr. Robinson Kendal, and ultimately the motion was carried on a show of hands.

The retiring directors and auditors were re-elected, and the proceedings terminated in the usual manner.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 9.		Business Done Week Ending June 9. Highest.		Lowest.	
Anglo-American Ordinary	60½,	61	60⅝		59½	
Do. "B"	90¼,	¾	90⅜		89⅜	
Do. "A"	33½,	34	33¾		32⅜	
Brazilian	8⅜,	⅝	8½		8 5-16	
Cuba	9¼,	¾	9⅝		9 7-16	
Do. Ten per Cent. Pref.	15½,	16½	—		—	
Direct Spanish	1¾,	2¼	—		—	
Do. Ten per Cent. Preference	10⅞,	11⅛	11		10¾	
Direct United States	10⅞,	11⅛	11		10¾	
Eastern	8 15-16,	9 1-16	9 1-16		8 15-16	
Do. Six per Cent. Debenture	102,	104	103		101¾	
Do. Five per Cent. do.	101,	103	102¾		101¾	
Do. Six p Ct. Preference	12⅛,	⅜	12⅛		12⅛	
Eastern Extension	9 1-16,	3-16	9⅛		9	
Do. Six per Cent. Deb.	107,	110	110		108½	
German Union	8½,	9	8⅝		8⅝	
Globe Telegraph & Trust	5⅞,	6	6 1-16		5⅞	
Do. Six p Ct. Preference	11⅞,	12	11¾		11	
Great Northern	9⅜,	¾	9⅝		9⅝	
Indo-European	22,	23	23¼		22	
Mediterranean Extension	2¾,	3¼	—		—	
Do. Eight per Cent. Preference	10⅜,	11¼	—		—	
Reuter's	9½,	10½	—		—	
Submarine	235,	245	—		—	
West India and Panama	1¼,	½	1½		1⅜	
Do. Six per Cent. Preference	7⅛,	½	7½		7 5-16	
Western and Brazilian	6½,	7	6¾		6½	
West. Union 7 p. Ct. 1st Mt.	117,	122	—		—	
Do. Six per Ct. Sterg.	103,	105	—		—	

TRAFFIC RECEIPTS FOR MAY, 1880.

Companies.	May, 1880.	May, 1879.	Increase.	Decrease.
Cuba Submarine Company	2,900 estd.	3,108	—	208
Eastern Telegraph Company	42,963	38,371	4,592	—
Eastern Extension Telegraph Company	26,570	25,845	725	—

ADDRESSES.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER, and 17, WATER-STREET, LIVERPOOL.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys, Type Printers, Recording Sounders, Duplex Apparatus (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

ELECTRICAL AND SCIENTIFIC APPARATUS.—WHOLESALE MANUFACTURERS OF ELECTRIC BELLS, ELECTRIC REVERSING INDICATORS, and CONSTANT MANGANESE BATTERIES. Telephone Switches and Transmitters, Induction Coils and Vacuum Tubes, Terminals, Carbons, Wire, and all materials. Instruments made, repaired, or altered on the Premises. Illustrated Bell list free. Complete catalogue two stamps. Special quotations to the trade.—DALE and CRAMPTON, Manufacturing Electricians, 4, Little Britain, London, E.C.

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SLIP

SAIGON.—According to the consular reports, Saigon now has 3,000 miles of telegraphic line.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—A meeting of shareholders was held yesterday at the Free Trade Hall, Manchester, to receive the report of the directors.

PROFESSOR JOSEPH HENRY.—Fifteen thousand dollars have been voted by Congress for a statue of the late Professor Henry, to be placed in the grounds of the Smithsonian Institution.

MADRAS.—The report of the directors of the Madras Railway states that the accounts of the working of the telegraph department in connection therewith during the half year are very satisfactory.

GREAT NORTHERN TELEGRAPH COMPANY.—The traffic receipts for the month of May, 1880, amounted to £19,480. Total traffic receipts 1st January to May 31, £85,720; corresponding months of 1879, £76,525; corresponding months of 1878, £80,870.

INDIA RUBBER FROM ECUADOR.—The exports of India rubber have for some years been gradually decreasing, thus, in 1876, no less than 10,138 quintals were exported; in 1877, 7,059; in 1878, 6,561; whilst in 1879 only 5,594 quintals were sent from the port of Guayaquil.

WEST INDIA AND PANAMA COMPANY.—The estimated traffic receipts for the half month ending the 15th May are £1,917, as compared with £2,569 in the corresponding period of 1879. Half month ending 31st May, £1,798 against £2,990. The February, 1880, receipts, estimated at £5,410, realised £5,488.

ALL IS WELL.—On Sunday, April 11, the telegraph lines between Melbourne and Port Darwin were put into communication, replies were instantaneous, the lines working perfectly. The cables were then cleared to Singapore, and an answer from there was received in Melbourne within one minute from the commencement.

SCOTTISH TELEPHONIC EXCHANGE.—The number of subscribers is increasing, and the number of conversations by telephone passed through this exchange exceeds 2,000 per week, which makes the average about 30 per subscriber, there being about 90 subscribers, of whom 20 or more were at the time of information not yet joined up.

CANADA.—The Canadian Government proposes to build a line of telegraph across Anticosti Island, from end to end, and to lay cables between Anticosti and the mainland, between Magdalen Island and Cape Breton, and between the mainland and Sable Island. Superintendent F. N. Gisborne is commissioned to contract for the cables in England.

COMPAGNIE FRANCAISE DU TELEGRAPHE DE PARIS A NEW YORK.—Notice is given that this company has decided to discontinue the application of the rules of the London Telegraph Convention for the counting of words as far as regards the traffic between the United Kingdom of Great Britain and Ireland and America. The rules for counting for such traffic will be the same as those which were in force on the transatlantic cables prior to the 1st of April, 1880.

SOCIETY OF ARTS.—The Council of the Society of Arts attended on Monday last, at Marlborough House, when the Prince of Wales, as President of the Society, presented to Sir William Thomson, F.R.S., D.C.L., LL.D., the Society's Albert Medal, awarded to him in 1879, "on account of the signal services rendered to arts, manufactures, and commerce by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables;" and to James Prescott Joule, F.R.S., LL.D., D.C.L., the Albert Medal for the present year, awarded to him "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work; thus affording to the engineer a sure guide in the application of science to industrial pursuits."

UTILISATION OF SOLAR HEAT.—M. Mouchet, whose name will be remembered in connection with this subject, is carrying on his experiments under the clear sky of Algeria. He is working with a mirror 3·8m. in diam., mounted so as to withstand the effect of the most violent wind, and concentrating the heat of the sun on a boiler 5mm. in thickness, within which a pressure of 8 atmospheres can be obtained in one hour. We should be glad to ascertain whether the *power* developed by this means would be sufficient to work a dynamo-electric machine of moderate size. The work hitherto done by M. Mouchet includes the sublimation of benzoic acid, the distillation of essences, and the concentration of syrups, the boiling of linseed oil, the carbonisation of wood, &c. It is probable that he may shortly take up the question of the generation of an electric current.

A NEW COMPANY.—The United Telephone Company (Limited), capital £500,000, in shares of £5, has been formed to carry out an agreement made between the Telephone Company (Limited), of the first part, the Edison Telephone Company of London (Limited), of the second part, and R. L. Harrison, on behalf of the company, to acquire any patents or monopolies for the use, sale, or manufacture of telephonic apparatus or any other invention or instrument for transmission of messages, and to manufacture, use, sell, or let any articles connected with the business and working of the company. The subscribers (who take one share each) are:—F. Crimp, 6, Old Jewry, solicitor; C. E. Webber, 36, Coleman-street, lieutenant-colonel; A. Fawkes, 36, Coleman-street, accountant; P. Simmers, 36, Coleman-street, clerk; A. White, 11, Queen Victoria-street, secretary; G. Twiss, 11, Queen Victoria-street, assistant secretary; A. F. Solomon, Leatherhead, solicitor's clerk.

USE OF THE ELECTRIC LIGHT IN PHYSIOLOGICAL RESEARCH.—The *North German Gazette* gives an account of some new experiments which have been made by the introduction of a coil of platinum wire, provided with a reflector, into the organs and cavities of the animal body. The light, it is said, was sufficiently powerful to render the interior of organs more distinctly visible than has heretofore been possible. By means of a probe a coil enclosed within a minute glass globe was inserted within the stomach of a live pike, the fish, whilst the current was passing, becoming quite transparent, so that the position and the movement of the internal organs could be observed. As in the case of the similar experiments by M. Trouvé with his polyscope, the fish did not appear to be inconvenienced by the operation, remaining quite quiet during its continuance, and swimming unconcernedly away at its conclusion. We fear that it is often otherwise when such experiments are tried on warm-blooded animals.

TELEGRAPHIC PROGRESS.—The telegraphic service, says *Engineering*, between the United States and Europe is in a satisfactory condition, but there is no good communication by wire between North and South America, or between the United States and Asia. Europe, on the other hand, has been wonderfully active in the extension of lines and cables to other continents. There are now two cables between France and Algiers; Cairo and Khartoum have been con-

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nected; a wire has been carried to Cabul; the Transvaal has been connected with Cape Town; and the latter place is now in connection with Europe, *viâ* Natal, Delagoa, Mozambique, Zanzibar, and Egypt. Another line has been established between Asterabad and Tiflis, through the whole of Persia, while Russia is extending its telegraphic network to Eastern Siberia. Much progress has been made in the domestic telegraphic system of Brazil, especially in the interior; a cable has been laid along a good part of the western coast of South America; and all the settled portions of Australia and New Zealand are now in active communication with one another as well as with Europe. A new cable connects Port Darwin, the northern terminus of the trans-continental line of Australia, with Java, Singapore, Malacca, and Penang. Several cables have been laid in the Baltic. The cables now required are one across the Pacific, two between the United States and Rio and Valparaiso respectively, as well as minor cables to connect Cayenne, Colombia, New Caledonia, the Phillippine Islands, and Chinese stations with the world's telegraphic system.

THE TELEPHONE IN THE WEST INDIES.—We have received a copy of *The Colonist* of May 13th, a daily paper published in George Town, Demerara, which contains a leading article describing the Bell telephone, then just received by the agent, Mr. Virtue, in Demerara. The writer says:—"It is simply perfection, and there is only one regret about it, and that is it did not find its way to the colony a little sooner. The local telegraph has done well, very well, and Mr. Benson, the energetic superintendent, deserves every praise for the way in which he has carried on his duties. But the utility of the telephone is quintuple that of the telegraph; it is not subjected to the errors of caligraphy and the obtuseness of copying clerks; none are admitted into a knowledge of your communication; the confidences of friendship and the secrets of trade are alike inviolable; before you tell your news, he whom you would address has answered you, and none other than he hears what you have to say; no sluggard boy dawdles on the road from the office to your house, improving the shining hours with "lick and pinch"; no longer need to rack your brain to fit your story in at twenty words for a shilling, and moreover stops and capitals are no longer a bar to clear understanding. Therefore as the work will, before long, have to be begun *de novo*, it is somewhat of a pity that Mr. Benson's skill and ingenuity should so far have been spent in vain. The era of clicks, dots, and dashes, is over, the human voice is triumphant over the symbols that but now were valuable and marvellous aids to the transmission of thought."

THE ELECTRIC LIGHT AT THE SLATE QUARRY, DES FRESNAIS.—The Angers Slate Quarry Company has decided to supersede gas in the subterraneous workings by the electric light, generated by the Gramme machine, and their engineer, M. Blavier, has for this purpose provided a 16 horse-power engine, working expansively, 6 continuous current dynamo-electric machines, and a suitable cable. At the present moment a single gallery, of 2,000 square metres is illuminated, the engine working up to from 4 to 5 h.-p. only. The following is the plant employed, with its cost:—

Two Gramme machines	3,230fr.
Three Serrin lamps (1 extra)	1,200 ,,
Various accessories	75 ,,
Cable, 1,400 metres	2,230 ,,
Prime motor, including boiler	10,000 ,,
Total	16,755fr.

The following items constitute the expense of lighting for the period of 22 hours, during which the illumination is continued in each day:—

Coal consumed (560 kilogs.)	16fr 80c.
Carbon burners.—(3·75m.)	8 ,, 40 ,,
Maintenance, lubrication (maximum)	5 ,, 00
Stokers & attendants (4 men)	12 ,, 00 ,,
Interest @ 10 per cent. on 20,000fr.	6 ,, 60
Consumption of oil during the descent for the workmen	1 ,, 20 ,,
Total	50fr 00c

The former expense in lighting with gas was 54fr.; but it is calculated that, for an equal expenditure, electricity would give ten times the illuminating power obtained with gas.

THE ELECTRIC LIGHT AT THE BLEACHING WORKS OF BREUILEN-ANGE.—The *Révu Industrielle* gives some interesting particulars relative to the system of electric illumination, which for some months past has been adopted at this establishment. The plant and its cost are as follow:—

1	Gramme Machine	1,500fr.
11	Reynier Lamps	1,100 ,,
11	Automatic Lighters	275 ,,
1	Interrupter	30 ,,
1	Galvanoscope	30 ,,
5	Commutators	150 ,,
20	White Glass Globes	40 ,,
10	Reflectors of tinned iron	50 ,,
285	m. of cable, and conducting wires	240 ,,
	Total	3,415fr.

The distribution of the 11 lights is as follows:—

1. Scouring Shed, 46·2 × 16·6 metres, 4 lights.
2. Bleach room, 19·7 × 16·6 metres, 1 light.
3. First drying room, 66·2 × 11·5 metres, 2 lights.
4. Second ditto 66·2 × 11·5 metres, 2 lights.
5. Engine room 10·7 × 5·6 metres, 1 light.
6. Room for generating machine 11·5 × 6·8 metres, 1 light.

At the velocity of 1,275 revolutions per min. the Gramme machine produces a light of from 8 to 12 Carcel *becs* (? about 100 candles) for each lamp, absorbing less than 3 horse-power. The expense for one hour's lighting is stated thus:—

Carbons for the 11 lamps	0fr. 65c.
Motive power, 3 h.-p., @ 0fr. 06	0 18*
Total	0fr. 83c.

Giving for an illumination of 700 hours a total expenditure of 581fr. The electric light has been found superior to gas-light, from every point of view, for the operations carried on at these works.

CHEMICAL AND ELECTRIC INDUCTION.—In a note on chemical equilibrium read before the Chemical Society, Mr. M. M. Pattison Muir says that "A consideration of chemical equilibrium from a dynamical point of view thus leads, I think, to the conclusion that chemical changes are always complex; that each change consists of at least two parts—a direct and a reverse change—that during the progress of either of these, secondary changes may be induced which will, in their turn, modify the primary changes; that systems not in phases of absolute stability tend to undergo change by contact with very minute quantities of matter in phases other than their own; such systems will always tend to pass into that phase in the passage to which the maximum loss of entropy (or gain of entropy, if the term be used in the Clausian sense) occurs; but that this tendency may, to a certain extent, be prevented by the action of impressed force. Chemical induction would, in this view of chemical action, be of much more frequent occurrence than is generally supposed. Indeed, it would be a part of every che-

* This would be almost exactly the cost of the fuel for the same h.-p. in London.—[ED. *E.*]

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mical change, becoming, however, more marked in some changes than in others. By thus extending the meaning of the phrase 'chemical induction,' we should, I think, find certain analogies between electrical and chemical induction phenomena. Just as electro-static induction is known to consist in a strained state of the medium, so chemical induction would also involve a state of strain in the reacting system; and as the breakdown of electrostatic induction produces the phenomenon of conduction, so would the breakdown of the strain in a chemically-reacting system be accompanied by a process of chemical change. Further, the strained medium would in each case be endowed with potential energy, which would become kinetic on the removal of the strain; and once more mechanical agitation might be regarded as probably favourable to the progress of a chemical change, just as it causes a more rapid recovery of a medium which has been strained by the process of electric induction."

German Underground Telegraphs.—The consul, Mr. Ward, at Bremen, Bremerhaven, thus writes in his report:—"An underground telegraph cable was laid last year by direction of the German Government from Hamburgh to Bremen, and from this town northwards to Bremerhaven, and westwards to Wilhelmshaven and Emden. By the construction of these lines a network of underground telegraphs has now been completed which connects Berlin with all the more important inland and frontier towns of the western half of Germany. The work, which was commenced about three years ago, has been successfully carried out by a well-known Berlin firm of engineers, who undertook the contract on receiving about 275 per cent. per kilom, including the costs of the cable itself and all other expenses of laying the same. The cable is deposited in the ground at a depth of about one metre, and is laid under the footpath of the main roads and streets, thus avoiding the often expensive labour of taking up and again laying the pavement of the carriage roads. Excepting in the case of three branch lines (below mentioned), which have four wires only, the German underground cable contains seven isolated wires, each 6-10 millimetre in thickness, encased in a covering of asphalte and jute-yarn, prepared according to a newly-invented process. An outer covering of another kind of composition is added for its future protection. The several main and branch lines of underground cable now in existence are as follow:—

	Wires.
1. Berlin, Halle, Francfort, Mayence	7
With branch lines, viz.:—	
a. Halle, Leipsig	4
b. Francfort, Strasburg, Metz	7
2. Berlin, Potsdam, Magdeburg, Cologne, Aix la Chapelle	7
With one branch line, viz.:—	
Cologne, Elberfeld, Barmen	4
3. Berlin, Spandau, Hamburgh, Kiel	7
With branch lines, viz.:—	
a. Hamburgh, Cuxhaven	4
b. Hamburgh, Bremen, Oldenburg, Emden.	7
With branch lines, viz.:—	
a. Bremen, Bremerhaven	4
b. Oldenburgh, Wilhelmshaven	7
4. Berlin, Schoneberg	7

The cable last mentioned is merely the commencement of a main line to be constructed—probably this year—in a southward direction; and further lines will shortly, it is stated, be laid towards the east and north-east portions of Germany, in order thus to complete the whole network of underground telegraphs which will connect the capital with all parts of the Empire.

Gas v. Electricity.—At the late meeting of the British Association of Gas Managers, held last week at the Institution of Civil Engineers, C. Hunt, Esq., C.E., who presided, compared the prospects of the electric light with those of gas. Public attention, he said, has for a lengthened period been directed to the claims of the electric light, to be considered, under its most recent aspects, as a rival to gas for the general purposes of illumination. Have we any greater reason to fear in it a rival now than at any past period of our history? Are we entitled still to term it the *ignis fatuus* of modern philosophers? or has it, in the words of one of the most distinguished of these, after having been in dreamland for sixty years, now come into the world of realities? These are questions that concern our future; and although we may reasonably believe that in the main they are in course of practical settlement in favour of gas, yet a brief consideration of them may not seem altogether undesirable. It is evident that the electric lamp, for ordinary indoor purposes, has yet to be invented. No advance whatever has been made towards the adaptation of the light to domestic requirements. It is not, however, to be inferred from this, or from the many failures that have occurred, that therefore in the present state of science the lighting up of moderately large interiors is impracticable. These have been various; but one defect that has been patent to all is the intolerable flickering and unsteadiness inherent in almost every lamp that has yet been introduced. As an instance of the extent to which this interferes with the efficiency of electric lighting, I may mention the results of some observations made not long ago at my instigation of the effect of a Jablochkoff "candle" in full combustion, placed within a clear glass lantern. These disclosed a rapid variation in the light afforded; the difference in the areas of illumination many times repeated within the space of only two or three minutes being represented by the proportions of about 9 to 4; that is to say, that while the observer was able, at one time, to see to read at a distance of 203 feet from the lantern, almost immediately afterwards the light became so contracted that he could only see to read the same print at a distance of 132 feet. This experiment was continued for some little time, and by three different observers, with practically the same results, although, as was to be expected, the distances arrived at by each were by no means the same. Within doors this defect has usually been overcome in a great measure by placing the lamps sufficiently close together to allow their circles of illumination to completely overlap; but so expensive a remedy is of itself an efficient barrier to the employment of any system depending upon it. Much attention, however, continues to be given to a matter of such vital importance; and not long ago there was exhibited, among others, in this hall, an improved form of lamp, the invention of Mr. Crompton, which is said to combine steadiness with simplicity of action. The brush system also has been introduced into this country from America, where, according to report, it has met with considerable success, and has been applied, amongst other uses, to the lighting of underground workings. The cost of production of the electric light per candle is, according to the most reliable evidence, so absolutely governed by the magnitude of the light evolved, and the ultimate value of the latter is so entirely dependent upon the use that can be made of it, that it seems impossible to arrive at any fixed notion with regard to the comparison with that of gas. All that we know with any degree of distinctness is that its superior economy has never yet, unless for very special purposes, been demonstrated either in this country or, I will venture to say, out of it.

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REPORT

It is reported by the *Scientific American* of June 5 that a Mr. G. R. Carey, of Boston, submitted "some months since" to the editors of that paper an invention for "seeing by electricity." It is pretty evident the editors were convinced that the invention was useless, or it seems somewhat singular that they should refrain from publishing the description of an invention which is hardly so common-place or so unimportant as to be thrust aside till Professor Bell's announcement "that he had filed at the Franklin Institute a sealed description of a method of 'seeing by telegraph,'" recalled to the editorial mind the prior description. Judging from the *Scientific American's* own columns, Mr. Carey would have remained in the limbo of the unknown so far as that paper was concerned had not Professor Bell filed this letter. Probably first thoughts were best, and it would have done no harm had Mr. Carey's invention remained in oblivion. We may safely say that the apparatus described was never constructed by the inventor, and had it been constructed we may venture to say he would never have sent a description to the *Scientific American*. A description of a similar idea, but with a great difference, has been published, as many readers will remember, by Professors Ayrton and Perry. Mr. Carey takes a disc, drills such disc with numerous small holes perpendicular to its face, each of which is filled partly or entirely with selenium. The description doth not say whether the disc is of conducting or non-conducting material. It goes on to say "the wires from the disc are insulated, and are wound into a cable after leaving the binding screw." A close study of the illustrations seems to show that from the battery binding screw a wire is taken to each selenium plug, and from the same end of the plug the wires are taken as above mentioned. These wires pass through a receiving disc, and are arranged in the same relative position as in the sending disc. Between the first and second receiving discs "a chemically prepared paper is placed for the image of any object projected against the sending disc to be printed upon." Modifications of the receiver are described, when we are told "The operation of the apparatus is as follows:—If a white letter, A, upon a black ground be projected upon the sending disc, all parts of disc will be *dark* (the italics are not ours) excepting when the letter A is where it will be light; *and the selenium points in the light will allow the electric current to pass* (the italics are ours), and if the wires leading from the disc are arranged in the same relative position when passing through the receiving disc, the electricity will print upon the chemically-prepared paper between the two receiving discs a copy of the letter A as projected upon the sending disc. By this means any object so projected and so transmitted will be produced in a manner similar to that by which the letter A was produced."

Report sayeth that neither the letter A nor any object so projected in the manner described will be reproduced, but as reports are so frequently incorrect it will be better to wait for an improved description of the apparatus, or a description of improved apparatus, before saying more. Meanwhile, some of those clever students preparing to submit themselves to the examination-mill may show where and why Mr. Carey's apparatus will fail.

Since the above was written we have read an adverse criticism of the apparatus by Mr. W. E. Sawyer in the *Scientific American* of June 12, which shows that scientific men are keenly alive to the necessity of "ideas" in accord with theory.

It will be noticed that the new French cable company has severed itself from following the London Convention so far as its Anglo-American messages are concerned. Under the Convention certain words, of a limited number of letters, in a limited number of languages, are accepted, but, outside the Convention, anything is or can be accepted. Hence, the Atlantic lines being outside the Convention accept any words or cypher, &c., the sender may think fit to use. We say the Atlantic lines, because what the new French line does at two shillings a word the Anglo-American does at sixpence per word, the Direct United States having the same rate as the new company.

The price of gutta percha is quoted this week as—genuine, 2s. to 3s. 6d.; reboiled, 3d. to 1s. 9d.

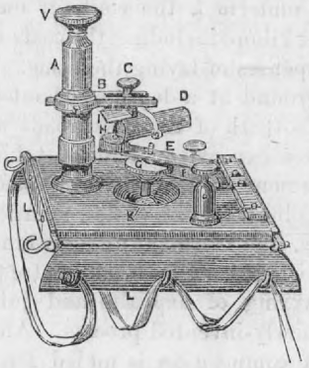
THE MICROPHONE: ITS MEDICAL APPLICATION.

(Translated from *La Nature*.)

At a recent sitting of the *Societé de Biologie*, Dr. Boudet, of Paris, described a very sensitive microphone, mounted on the double spring of a sphygmograph, which enabled him to carry out some interesting researches in aid of M. Charcot, of the *Salpètrière*. The small volume of this instrument renders it very handy, and allows of its being applied to any part of the body.

A small plate of vulcanite, 5 by 2 centimetres, very slightly concave, and pierced with a hole in the centre, serves as a stand for the apparatus. At one end there is an upright about three centimetres high; on this rod moves up and down, by means of a regulating screw, a small carrier on the transverse axis of which is pivotted a cylinder, D, of carbon, 1·5 centimetres long and 5 millimetres thick. Beneath this first carbon is placed the free extremity of a thin spring, H, arranged horizontally and fixed to the opposite extremity of the stand. To this spring is attached a small button of carbon, which comes into contact with the end of the oscillating carbon cylinder. Lastly, beneath this first spring and parallel to it, as in the sphygmograph of M. Marey, is placed another spring ending in an "exploring button," which traverses the opening in the stand.

The smallest pressure applied to this button is transmitted by means of the springs to the two carbons in contact, and thus causes a variation in the intensity of the current traversing them; these variations are rendered appreciable by a telephone which the operator applies to his ear. The mobility of the two carbons in contact renders intelligible the extreme sensitiveness of this microphone. It is necessary, however, in experiments with the instrument, to obtain a first degree of initial pressure, which is in part produced by the regulating screw, since this allows the oscillating carbon to rest in a greater or less degree upon the button beneath. But this alone is insufficient, for, if a somewhat strong pulse is being examined, the motion communicated to the springs would jerk up the oscillating carbon, and produce interruptions in the current.



We have remedied this defect, says M. Boudet, of Paris, by placing within the carrier, over one of the extremities of the oscillating cylinder, a small fragment of paper *(papier écolier)* bent in V form, and which plays the part of a spring. We will not here dwell upon the utility of the addition of this paper spring, which was suggested by ourselves, and the advantages of which have already been pointed out in several scientific journals. We will simply recall the fact that paper is a body of very weak, but very perfect elasticity, as was proved by the experiments of Savard; consequently, it adapts itself much more perfectly than steel or india rubber to the make and break of contacts between the carbons, or, rather, to the variations of the pressure they exert upon each other. Thus arranged, the apparatus, when placed upon an artery, indicates all the sounds produced in the interior of the vessel; and, with a little practice, it becomes easy to distinguish the rythmical differences, the blowing sounds, &c. The pulsation is very strongly marked, the normal dicrotism becomes perceptible, and, in a word, *one hears the tracing of the pulse*, just as it is shown by the sphygmograph.

Applied on a muscle, the same instrument becomes an excellent *myophone*. It reveals the sound of the normal muscular tonus, and, during contraction, one hears perfectly the rolling sound which is characteristic of this phenomenon. The tone of the sounds transmitted by this microphone is preserved in all its purity. This may readily be verified by causing tuning-forks of different tone to vibrate near the instrument, or even in contact with its base. The telephone will faithfully repeat the note emitted by each of them, and, what is more curious, one may even distinguish the sounds of two different tuning-forks vibrating together, without the tone of either being altered.

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Microphones somewhat different in form to the above have been constructed for the purpose of studying muscular contraction in the case of animals.

PHYSICAL SOCIETY.

JUNE 12.—Dr. Huggins, F.R.S., in the chair. New members: Mr. H. B. Juff, Mr. Adam Hilger, Mr. C. V. Boys.

Dr. SHETTLE, of Reading, read a paper "On the Influence of Solar Radiation on the Earth's Rotation." The fact established by Dr. Shettle that the magnetic energy of a bar magnet acts along spiral lines has led him to surmise that the energy emanating from the sun and impinging on the earth on the zone of the ecliptic, traverses the earth in a spiral path, and finally emerges at the magnetic poles. The spiral of energy is "right-handed" at one pole and "left-handed" at the other, like the magnetic force in a magnet and the electric discharge in Crookes's vacuum tubes. Owing to precession and nutation these spiral paths are constantly changing and producing magnetic variations. He, therefore, infers that the magnetic poles will complete a cycle corresponding to the period of precession. Dr. Shettle thinks that bodies exhibit magnetic properties in proportion as they change the direction of the energy traversing them, and throw it into the spiral form. Terrestrial magnetism would be due to the solar radiance on this hypothesis. Gravity, also, would be produced, so likewise would the earth's rotation (by a kind of "magnetic whirl"), electricity, tornadoes, cyclones, waterspouts, and whirlwinds. Moreover, this "spiral energy" would seem to operate throughout the whole universe.

Professor WIEDEMANN, of Liepsic, made a communication "On the Phenomenon of Interference in Rays of Long Path," and showed how the phase of vibration of the atom or molecule emitting the rays influenced the phenomenon. Molecular collisions could operate in preventing interference. From a study of this question he was able to deduce a method of determining the pressure on the surface of the sun and stars. He mentioned that he had found that the temperature of a glowing gas in Geissler's tubes may be under 100° C., and therefore the light of the aurora or of comets might be accompanied by a low temperature. He had also determined that the quantity of heat produced in a gas by the electric discharge was always the same with the same amount of electricity, whether discharged at once or not, and that it increases nearly in proportion to the pressure of the gas. He had also determined that the heat which must be developed by a discharge in hydrogen in order to change the band spectrum of H into the line spectrum is about 100,000 calories for 1 gramme of hydrogen, and hence this might represent the amount of heat necessary to transform the hydrogen molecule into its atoms. Dr. Schuster suggested that Professor Wiedemann should make a similar experiment with another gas, say nitrogen, as there was a disagreement about the H spectra, and Professor Wiedemann stated that he so intended.

Mr. RIDOUT exhibited a device for amplifying small motions. A small barrel is slung by two threads between the prongs of a metal fork in such a manner that, if the fork is bodily carried to and fro, the barrel will rotate round its axis. This is simply effected by making each thread in its passage from one prong to the other take a few turns round the barrel. To the barrel an index is attached, and the fork is then fixed on the body whose minute motion is to be indicated. The translation of the body shifts the fork and rotates the barrel, which in turn deflects the index round the face of a dial, and the magnifying power is expressed by the ratio of the diameter of the barrel to the length of the index. With this apparatus Mr Ridout exhibited the lengthening of an iron core when magnetised by the passage of the current of two Grove cells through an insulated wire coiled round it. By rivetting a slip of brass to the iron the unequal expansion of brass and iron under heat were also shown, the heat being generated by keeping the current flowing in the coil.

Mr. D. WINSTANLEY exhibited his new radiograph, for recording graphically the intensity of solar radiation throughout the day. It consists of a differential thermometer, with one black bulb and a circular stem. The lower part of the stem is filled with mercury, the upper branches with sulphuric acid and water. The tube is mounted on a brass wheel, so that when the black bulb is exposed to the sun's rays the differential motion of the mercury causes the wheel to turn. The wheel carries a light index or marker, which is free to traverse a vertical cylinder covered with paper coated with lamp black, and leaves a white track where its point has scratched off the soot. The radiogram thus produced can be fixed and preserved. Dr. Guthrie pointed out the curious "thermal twilight" these radiograms had betrayed to Mr. Winstanley. They show that before sunrise the temperature increases owing to solar radiation. Moreover, half an hour after sunset the index falls, and remains till within a few minutes of midnight, when it mysteriously rises and sinks again, although the sun is then directly over the opposite hemisphere.

Mr. BAILLIE then gave the results of a study he had made into the theory of the phoneidoscope. He finds that waves simultaneously start from each side of the soap film when the note is sounded, and, meeting in the middle, generate neutral points and notes. The equations of several cases were given by him, and he suggested that photography should be employed to fix the appearance of the figures, in order that they might be investigated theoretically.

THE INTERNAL RESISTANCE OF MAGNETO-ELECTRIC MACHINES IN MOVEMENT.

In order correctly to determine the efficiency of a dynamo-electric machine, it is advisable to know the internal resistance of the bobbin when the machine is working, and some interesting experiments have been made in this direction by M. Cabanellas, a French electrician.

M. Cabanellas proposed to himself the problem of finding a simple and direct method of measuring the resistance in question, say, for an ordinary Gramme machine, with two brush contacts. The great difficulty to be overcome consisted in eliminating all the causes of induction currents in the ring whose resistance is to be measured, since these induced currents tend to disturb the measurements, so as to render it impossible to take them on the Wheatstone bridge, for example.

The induction of the electro-magnets and iron cores of the machine can be avoided by turning the ring, carefully set with its brushes upon wooden supports; but the induction of the earth's magnetism would still remain to be got rid of, and this effect would be greater or less according to the orientation of the plane of rotation.

M. Cabanellas has made these difficulties vanish in opposing to each other the two effects of terrestrial induction produced in two identical Gramme machines, movable under the same conditions, and having their axes placed parallel to one another. Under these conditions, the two electromotive forces destroy themselves completely, and M. Cabanellas has succeeded (by the help of M. Saquet, electrician to the Parisian electrical mechanicians, Messrs. Sautler, Lemonnier, and Son) in making a number of measurements of the double resistance of the ring in rotation. This was done by means of the Wheatstone balance and a Siemens universal galvanometer.

It should be remarked that the identity of the two rings is not absolutely indispensable, since the compensation could be managed by means of a difference of speed. Moreover, the process might be applied to several different machines, taken in groups of three, and connected two by two. By taking a series of measurements at different rates of velocity, the law of the relations between speed and internal resistance could, doubtless, be determined.

At present M. Cabanellas is only able to give results obtained from two machines, of the Gramme type known as A, which furnishes a continuous current to the brushes. He finds that the resistance of the ring at a speed of 450 turns per minute is about 25 per cent. greater than its resistance when at rest. And this is with the temperature practically the same in both states.

This difference between what may be called the dynamic resistance of the ring and its static resistance appears to be mainly, if not entirely, due to the constitution of the ring. It was not in the least modified by the intervention of metallic resistances in the ring circuit, nor yet by variations of electromotive force in the ring. Perhaps the true cause is to be sought deep in the molecular nature of things, and may reside in the motion of the ether within the rotating ring. To throw more light on the matter we would recommend M. Cabanellas to try experiments with simple coils or wires in motion in order to determine the law by which conductivity varies with the velocity of the conductor.

When high electromotive forces are generated in the ring or bobbin of the dynamo-electric machine to be measured, it will be necessary to discard the ordinary Wheatstone balance in practice and employ special graduated resistances of thick wire and particular galvanometers. M. Cabanellas has measured the resistance in question up to an electromotive force of 100 volts, using for the purpose the current from a D closed Gramme machine in action. The intensity of the current in the ring being i webers (per second), and the difference of potential between the two extreme brushes of the connected rings being represented by e volts, the resistance of the ring r is given by the ratio,

$$r = \frac{e}{2i}$$

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THE ELECTRICIAN.

TO CORRESPONDENTS.

We cannot undertake to return drawings or manuscripts, and must, therefore, request Correspondents to keep copies.

All letters intended for insertion in THE ELECTRICIAN, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

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SCIENTIFIC LITERATURE.

The letter under the heading of "Electrical Paradoxes," published in our last number, revives a very old grievance, which ordinary readers as well as competitive students have to endure at the hands of scientific literature. The instance mentioned by our correspondent of a youth asking whether the person imagined, as illustrating Ampère's rule, reclined on his stomach or on his back, is only one of a hundred similar difficulties which could be cited against writers whose business it is, if they venture into print at all, to make themselves perfectly intelligible. When a candidate enters upon a competitive examination, he is, to some extent, forewarned of a "catch," just as the schoolboy, home for his holidays, suspects a fraud in the floorer which the family doctor is always ready to discharge upon him. After solving the recondite problem as to the connection between the cost of shovel and tongs, and what the coals will "come to," he is prepared to be sceptical about the differing weights of a pound of lead and a similar pound of feathers. Examiners nowadays are driven to such straits that their papers always embrace questions even as fatuous as these; and all that can be said for them is that they exercise, and are to some extent a test of, the ingenuity of the candidate. Whether this is the object primarily aimed at, and whether, for example, a student's knowledge of electrical laws can be estimated by his skill in seeing through the superfine trickiness of the examiner is another matter. At present the real competition lies mainly between the professional coach and the professional framer of questions; when these belligerents are fairly exhausted perhaps the turn of the peaceful student may come.

One conspicuous merit, however, the examiners have which is denied to or not sought after by the literary scientist—they know what they want to do, and do it. The exquisite pains they take to fog their victim is as admirable as it is entirely successful; and if half the trouble were taken in other quarters to make things clear that is here devoted to making things cloudy we might hope to understand most of what we read, and popular science would then be a reality instead of a popular delusion. Something may be said for competitive examination if it train our future teachers in the art of going to the root of the matter, stripping it of verbal superfluity, and laying it bare to one's intellectual vision. That past and present teachers have not succeeded in this, is, with rare and notable exceptions, a fact which our readers' experience will, we fear, only too painfully bear us out. A scientific announcement, so far as it announces anything to be usefully considered and verified, is too generally a scientific—or, rather, a literary—hoax, the essential part of it being omitted or explained with such inexactness that nobody can possibly follow it. We don't pretend to be immaculate even ourselves; but we have to take things generally as we find them; and that we do not often find them to our liking is evident by the tone of these remarks.

The art of putting things clearly is no more a natural accomplishment of the scientific faculty than draughtsmanship is of the inventive faculty. On the whole the inventor possesses more of the art we are desiderating than does the discoverer; and thus it is commonly noticed that whilst the published explanation of a new invention is concise and perfectly clear even without the aid of the diagram which usually accompanies it, the published accounts of new discoveries or novel theories are diffuse, involved, inconclusive and vague. There is often wanting to these latter that which is the very essence of all lucid exposition, namely, an unequivocal desire to make itself understood. Intelligent and independent editing is needed in cases like these; and if the scientist would oftener stoop to this he would have his reward in a wider circle of readers. Men of solid learning often sneer at the popularity of meretricious pretension. But if the field is clear for bookwriters of that class it is chiefly because the other class has little but its solidity to recommend it. A little transparency is greatly to be desired. The other day we were informed by a celebrated experimenter in the good solid style, that "into a glass tube *closed at the ends* he *introduced* perfectly *pure* and *clean* water." Now it is evident that the writer here was more careful of taking trouble than on making his meaning clear. A simple closed glass tube containing water was the esential condition, and the clean and the pure water "introduced" into a tube already closed at the ends are all mere confusions. Here the details are surplusage; and the same may be said of very much that we have lately had to wade through. Such, indeed, is the passion nowadays for detail—the circumstantial conditions of the experiment—that we sometimes feel a sort of disappointment at not being told the pattern of the wall paper and the rent of the room in which the experiment was made. Quite as frequently, however, the fault is in the absence of detail. Here is a sample: "A horizontal axis carries a *collection* of little circular glass plates at small distances from one another." This occurs in a recent description of a new static induction machine; and all we can say is that if the writer had given himself the same amount of trouble to state the position actual and relative of the glass plates that it probably cost him to hit upon the meaningless word "collection," his industry would not have been wasted.

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We need hardly say that our text books are full of the faults we are here commenting upon. Taking down a popular handbook, we open it absolutely at random, and the first passage that catches our eye reads thus: "When two dissimilar metals are plunged side by side into an acid solution, they do not exhibit any signs of electrification." We sincerely wish that this were the worst example we could find. But such as it is, what is the significance, if any, of the *plunging* process? or what is exactly meant by "side by side"? Finally, the unlearned student may be excused for asking Would *similar* metals behave differently? If not, where is the point in their dissimilarity? Again, a few pages further on also selected quite haphazard, we are told that "when the current is a straight line of indefinite length like a telegraph wire, a magnetic pole in its neighbourhood is urged by a force tending to turn it round the wire." Here the afflicted student will agree with us that the straight current of indefinite length and like a telegraph wire is an element of gratuitous bewilderment which calls for some kind of justification, and is not at all made better by turning the neighbouring magnetic pole round the wire to which the current is merely likened. One of the best text books we are acquainted with is evidently far from faultless; for opening it in the hope of illustrating our meaning by an example of careful description we are confronted with the following: "Gas is frequently given off on the surface of the zinc *which* covers the metal so as to protect it from the liquid and causes polarisation." This is not merely grammatically wrong, it misleads the student by the use of the term "protects," when *preventing* or *hindering* the essential operation is what should be impressed upon his observation. Instances of a provoking lack of exactness are common to scientific "papers" as well as to scientific class books. Quite recently we were assured in respect to an otherwise promising experiment that the effect was "much more strong when the *two poles* of the magnet were *brought* very close together." We confess that we did not see our way to easily "bringing" them closer together; nor did we verify another experiment of about the same date which directed us to fasten a short tube of soft iron to the vibrating plate of a Bell telephone. There are at least two ways, and some people might say three, of fastening a tube to a disc, and we wanted to know which was the right way; but this is precisely what the writer omitted to specify.

These omissions, slips, and redundancies would often be very laughable if they were not so very discouraging; and we sometimes wish that a sense of humour were rather more prominently developed in our writers on serious science. It would protect them from many a ludicrous situation. The term "body" ought to be abolished from the scientific vocabulary unless the writer can be sure of appealing to an audience that has forgotten how to laugh. Not long ago we saw—in print we mean—"a body immersed in dilute acid." The person who penned this description must have been nearly related to the one who, in describing the money value of a well-known form of battery, spoke of "the profit Daniell derived, &c." But that was a long while ago. A contemporary, however, exceeds him in obtuseness when, in his anxiety to show us how clever he is, he tells us that he used for his experiments upon lightning conductors *either* a telephone *or* a frog's leg. It does not seem to have mattered much to him which; whether it mattered to the frog he does not stop to mention; but this is not surprising, seeing that our informant is equal to the statement that "each time a spark passed the induced effect was visible *(sic.)* on the distant telephone or the frog's leg." The impertinent inappropriateness of this unhappy frog, or fragment of frog, is beyond all dispraise, and we are glad to remember that it was not an Englishman, nor even a Scotchman, who showed such supreme incapacity for seeing the absurdity of his language. It is to Englishmen, however, we are now briefly addressing ourselves, and they cannot claim any immunity from sharp criticism so long as they despise the ordinary aids to lucid and dignified explanation which the long-suffering student has a right to demand of them.

CORRESPONDENCE.

CARBONS AND DIFFUSION APPARATUS FOR THE ELECTRIC LIGHT.

(CONTINUED.)

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Very few words will be sufficient to describe the improvements which have been made since 1846, when the first patent for the manufacture of carbon rods for electric lighting was taken out by Messrs. Greener and Staite, as raw material carbon of gas retorts, foundry coke, lampblack, and charcoal have been used, and as agglomerating mediums, sugar, gomme, molasses, starch, glues, &c., in fact, any kind of agglutinating materials have been all patented over and over again, but with no improvement in the ultimate product. Within the last eighteen months or two years several patents were taken out by different persons, but there is absolutely nothing new in them except the names of the patentees, who (or some of them, at all events) appear to have rushed into the manufacture of carbon rods as soon as they heard that possibly the electric light was coming on, trusting that some day the public might be dazzled into subscribing capital towards the formation of a company of some sort to work their so-called patents. Some patentees have introduced wires of copper or of iron into the interior of the carbon rods, with what result it is needless to inquire, as a knowledge of the first rudiments of chemistry on the one hand, and of the laws of expansion on the other, easily disposes of the value of the introduction. Some others, like Mr. K. Hedges, advocate the introduction of certain oxydes of metals likely to impart to the light a certain colour to hide the natural colour of the electric arc until the public get accustomed to its brilliant whiteness, or, in other words, Mr. Hedges, and those who follow the same principle, propose simply to adulterate the electric light; but of real, genuine improvements, beyond those introduced by Mr. Gaudain, and attempted by Mr. Jaquelin, there have been none. It may be the quantity of these carbon rods actually required, and probably to be required for some years to come, is too small to warrant any large outlay of money with a view to simply secure the manufacture of the best article for the future. Probably in time to come, however, the best carbons will be manufactured on a process based on that of Mr. Jaquelin. As I said in my last, Mr. Jaquelin based his manufacture of carbon on a sound theory. Not being able to obtain carbon in a fused or dissolved state, he took the only course open to him to arrive at a perfect conglomeration of the molecules of carbon just at the time this material is disengaged from some of the gaseous compounds it forms with hydrogen. The plan followed by Mr. Jaquelin unfortunately necessitates the mechanical cutting of the rods from the block of carbon he produces, and this entails no small expense, and constitutes no little drawback. A modification of his process or plan is, however, possible, and by a very simple arrangement the carbon rods, after having been moulded, dried, and baked once, can be completed by following part of Mr. Jaquelin's valuable discovery. Moreover, Mr. Jaquelin manufactured the hydrocarbides he required direct from the coal, and having eliminated from them the carbon they can part with, used them no more; I use them again, and make them take up again as much carbon as they left behind in the rod they had to pass through; by such means a carbon rod of perfect compactness and homogeneity is obtained at less cost and labour than by the ordinary processes.

DIFFUSION.—The peculiarity of the electric arc is that it is entirely composed of sharp, well-defined rays, and hence the necessity of diffusing, that is of spreading it, or, to better, perhaps, express my meaning, of fusing together all the rays into a compact luminous focus, something similar to what is naturally produced in the flame of gas, or petroleum oil. It seems to me that all the different contrivances hitherto termed "diffusers" (permit me to use the term) are wrongly named;

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the only action of these apparatuses, globes or screens, as they may be called, is to prevent the rays of light from reaching the outside in the form they are emitted, or, in other words, they hide the light, with an inevitable loss of from 40 to 60 per cent. of the illuminating power of the arc.

Now, in my opinion, a diffusing apparatus, really worthy of the appellation, should possess the property of dividing each ray of light into numberless ones and send them across each other, without any of the light being lost, and then reflect them for use.

The diffusion of light is intimately connected with its reflection, and it may be said that there is no real diffusion without reflection. To explain my proposal: If I suppose a luminous point striking a plane surface of looking-glass, I shall have only one luminous point reflected, and at an angle equal to that at which the luminous point strikes the glass; if I have as reflector a pan of glass composed of 10, 100, 1,000 or more small plane surfaces, I shall have my luminous point reflected as many times. Now, if these plane-reflecting surfaces are placed at different angles towards the source of light and towards each other, not only the reflected rays will strike what I may call fancy, though well-defined, courses, but will also cross each other, and if I carry the division of the reflecting surface far enough, the focus of light as reflected will have lost its originality and only appear as a luminous globe.

In some factories where the electric light is employed as the illuminator of a large room, a similar principle of diffusion is adopted. The focus is placed in the middle or in a corner of the room, and screened from view by a reflector having the shape of an inverted umbrella; the light thence is thrown on a white-washed ceiling, and from there it comes down perfectly diffused and illuminates all the room; the rays strike on every molecule of the chalk composing the whitewash, and by them are reflected in numberless different ways, and the rays are so split that their originality can no longer be distinguished. This certainly is diffusion without waste.

Many of your readers, perhaps, have looked at a bright piece of foundry coke, and perhaps a few have noticed how well the rays of light striking its surface are diffused. If a piece of such coke is held on one side of the arc, and on the other side is placed between the arc and the eye a screen perfectly hiding the luminous point from view, it will be noticed that the piece of coke is shining brilliantly, but gives no distinct rays. Now, supposing that that piece of coke, by some means or other, has its power of reflection greatly increased, it will constitute a perfect "diffuser."

Such is in substance the diffuser I propose. The material may be coke, glass, or porcelain, provided the surface is rough, and that it has received a coating of platinum, the result will be the same.

How to adapt this diffuser to street electric lamps or in reading rooms, or, in fact, in any place where the electric light is employed, and also how to reflect the light from one place where too great a quantity exists to another place where that extra quantity would be beneficial, will be the subject of my next letter.

—Yours, &c.,

A. VASSARD.

16, Annandale-road, East Greenwich, S.E.

PRACTICAL PAPERS BY PRACTICAL MEN.

ELECTRIC BELLS.

BY W. MOSELEY.

(CONTINUED FROM PAGE 20.)

The description given of the method adopted for securing good and permanent insulation of the "main" wire, although designed chiefly for fittings on board ship, is equally applicable in buildings, but the necessity is not admitted, and as we are going to describe another and cheaper alternative, the adoption of the more perfect system may be still further delayed, except for ship purposes. In any case, it is necessary in ships to have better insulation at the point of attachment of the branch from "main" wire to the "contactor." The ordinary kind having a long and short flat brass spring not only soon perishes but the battery soon runs out its strength, hence the benefit of the superior insulation of the main wire is not apparent for some time unless the precise sources of current loss are sought out and measured. Roughly speaking, a ship may be fitted with, say, a hundred and fifty contactors, having the ordinary two flat springs on a flat disc, and a careful test of all the circuits may exhibit perfection in the action of all the apparatus, and the loss of current during inaction of the instruments may be nil at the time of going to sea, but an ordinary voyage brings the enemy on board—salt water, which finds its unerring way into every groove and cranny where the wires lie, the wires themselves even forming so many grooves and capillary tubes to invite the salt water, so that when the water has found its way to the majority of the contactors there are so many circuits established, and the battery is made to undergo a process of automatic exhaustion. And since it is often found that the loss of current at the contactors amounts in the aggregate to about one-fifth of the force necessary to work the instruments, it is no wonder that the battery is often found exhausted in a few weeks. The remedy we have applied to remove this waste at the contactors is as follows. The line wire is attached to the circular metal base of the contactor. Into the centre of this base is fixed a circular plug of ebonite, projecting in front about a quarter of an inch, with a feather-edged flange. Through the centre of this plug the branch from "main" wire passes, the rubber covering of which is pulled into the conical hole at back, and the bare end then fixed by a centre metal screw, or soldered in a silver cap. By means of a three-legged spring the circuit is closed at pleasure by the usual pressure of a centre button. In regular use it is rarely found that any water ever touches the centre, where contact is made, and after a rough voyage on a ship where about two hundred of such contactors are in use, no appreciable loss is ever detected. Now, in order that every advantage should be derived from the prevention of waste when the instruments are at rest, it is necessary to secure a good insulated conductor for the current required to actuate the instruments.

The usual course is to ignore the question whether the return wire should be insulated or not, for, theoretically, *it is supposed* to be laid down that the return never needs insulation, and the more learned the more blind are the cognoscenti in this respect. It usually follows, therefore, that all the money that can be afforded for good insulation is spent on the covering of the line wires, whereas with a highly-insulated return wire half the expense of line wires may be spared. An examination of our remarks on illustration, Fig. 2, with reference to any actual case will explain the rationale of the above statements.

It may be inferred, from our strong objections in former papers to the ordinary method of fixing wires under staples, that we deprecate the use of staples; and so we do except for a single wire under one staple. The various methods available for obviating the staple evil will be described further on. Our object before we conclude is to show how, with less outlay and less experienced fitters than at present necessary, a far more perfect and reliable system is available for all localities and circumstances. Meanwhile we must endeavour to clear the ground of several tenacious prejudices on other points. Since 1873 we have exclusively used, in place of the ordinary "trembling bell," the "short circuit" action, the difference between the two being that in the ordinary bell the circuit is broken as the armature approaches the electro-magnet; but in the "short circuit bell" the electro-magnet is cut out of the circuit by closing the circuit through the armature as it approaches the electro-magnet, thus shortening the circuit by the length and resistance of the wire on the electro-magnet. Hence the name.

The utility of this action being adopted largely in important practice, in addition to the palpable advantages "on the face of it," should suffice to bring it into universal use; but, instead of that, cold water has been thrown on it in the scientific columns of various papers. It is said to be a very old idea, of little practical importance, if any.

Amongst other statements it is alleged that Mr. Breguet described it in a work "*now out of print*," about 1865. We would that more authoritative and distinct objection were set forth in some high quarter, or else let the advantages be endorsed when such matters are in review. It is stated that with the utmost skill in its construction the action of the "short circuit" bell is not so good as the "make and break" bell. For want of faith and patience, and perhaps a little more gumption, there may be a difficulty—self-created or inherent who shall decide?—but it may perhaps be well to shunt any discussion of the difficulty on to an old line.

One of the simplest and first steps in mechanics is perhaps the last, if ever, mastered, viz., the right use and value of the hammer. The probability is that a little error in the adaptation of the hammer and spring action is mixed up with a want of faith in the demagnetisation of the electro-magnet. The confusion is increased by the ever-existing fact, the residue of magnetism after every interruption of circuit.

An ounce of proof is worth a pound of argument is a maxim never more pertinent than in such a case. Meanwhile, waiving the question whether the hammer strikes with as much vigour, which is really insignificant compared to other points, let us consider the three essential advantages obtained by the short circuit action.

1st. The maintenance of a complete circuit without depending upon good contact between the spring and the armature of the

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make and break action. Every fitter of electric bells, after a little experience, meets with instances of complete stoppage of communication in every place that terminates in one large case of indicators, simply on account of dust or oxidation between the points of contact. A quack doctor never felt prouder of an accidental cure than the electric bell fitter feels when he has the means for restoring peace and comfort to a distracted household literally between his thumb and finger. At the right moment —in his philosophy, probably—he applies the thumb and finger, makes the points of contact scratch a clean place, and at once everything is in order again. Such difficulties, but not we hope such happy moments, are impossible where the short circuit bell is in use. The sudden impact of the armature on the short-circuiting spring ensures good contact there, but in the old form dust and damp and variation of temperature when the bell is at rest not unfrequently interrupt the metallic contact.

2nd. The short circuit action cuts out the resistance of the electro-magnet, and gives the other instruments so much extra electromotive force. The indicator, for example, in a simple arrangement of one bell and a set of indicators, then receives the whole force of the current at every beat of the bell hammer.

3rd. The circuit being only shortened instead of interrupted at exery beat of the hammer, several bells and indicators may be worked in one simple circuit.

For example, if an additional bell is required in any place where a line wire traverses it is only necessary to cut the wire and attach the ends to the two terminals. Whereas two or more bells of the ordinary kind can only be worked at once by leading so many additional wires.

(TO BE CONTINUED.)

NEW TELEPHONES.

The recent amalgamation of the two English telephone companies (the Bell and Edison) is a matter of congratulation. By uniting they will change expensive and annoying warfare into mutual advantage, and occupy the field against all comers. The Edison transmitter, which is hitherto the best of all, will then be used in connection with the Bell receiver, which is likewise peerless of its kind, and the combination of these two instruments will be a benefit to the public.

The progress of telephone research has to some extent fallen off lately, but during last year there were one or two serviceable telephones brought out. Mr. Geo. M. Hopkins recently described an interesting transmitter of his invention in the *Scientific American*. The transmitter is fixed to a bracket, and stands vertically with its sound-collecting mouthpiece pointed in the direction whence the sound proceeds. The receiver, which is an ordinary Bell instrument, stands when not in use over a curved pendent resonator, the smaller end of which projects through the shelf of the bracket, and just enters the hole in the centre of the receiver mouthpiece.

Between the transmitter and receiver there is a small induction coil whose primary wire is connected with the local battery and transmitter. One terminal of the secondary wire of the coil is connected with the receiving instrument and line, the other terminal is grounded. The instrument is an ingenious form of microphone transmitter, and consists, as usual, of a diaphragm and mouthpiece to receive the speaker's voice, a carbon button attached to the under side of this diaphagm, and, pressing up against this button, is a light rod of fine carbon floated in a bottle of mercury. The carbon button is of ordinary battery carbon, the rod of electric light carbon. The bottle is a phial with a rounded bottom like an antique tear-jar. The circuit through this microphonic contact is made by means of a platinum electrode fused into the bottom of the phial so as to reach the mercury, and a wire making contact by means of a light spring with a leaf of copper foil lying under the diaphragm, and fixed between the latter and the carbon button. The current, therefore, passes by one wire, the foil, and carbon button to the carbon rod and mercury, thence by the platinum wire to the line.

The carbon rod is $\frac{1}{8}$in. in diameter and furnished with a round point, which is pressed by the buoyancy of the mercury against the under surface of the button, which is filed as plane as it can be. Hence the vibrations of the diaphragm, besides pressing the microphone contact, also dip the rod into the mercury, which forms a very equable fluid spring. The height of the telephone is about six inches.

The diaphragm, which is of mica, is rather stiff and firmly clamped in its chamber, the frame being of wood, well soaked in paraffin, or, better, vulcanite, so as not to be liable to warp.

The induction coil used with the instrument is of the ordinary form, two inches long, one inch in diameter, with a $\frac{3}{8}$in. core of No. 18 soft iron wire. The primary cell consists of No. 18 silk-covered copper wire, and the secondary of No. 36, in sufficient quantity to fill the spool. One cell of Leclanché or Fuller's battery will work the transmitter, but two will augment the volume of sound.

As to the efficiency of the instrument, it will bear comparison with other transmitters, and in one or two points it seems to have a slight advantage. It will transmit speech clearly whether the speaker be within ten miles or as many feet from the instrument. Although a call bell may be used in connection with it, generally none will be required, as by saying 0-0-0-0 loudly into the mouthpiece a trumpet-like note is heard at the other end of the line in the receiver there, which, though not very loud, is sufficient to attract notice in a tolerably quiet room. It would be easy, we imagine, for Mr. Hopkins to add an efficient call to this instrument, and he would thereby greatly improve its efficiency, for a weak call is a decided disadvantage.

Another promising transmitter is the micro-telephone transmitter by Mr. Hunnings, which was patented in 1878, but has since then been brought by degrees to a very efficient state. The earlier form consisted of a diaphragm of ferrotype iron or platinum or silver, and a disc of brass placed near it behind; the intervening space being filled with carbon powder about 1-16 inch deep.

The circuit was made through the diaphragm and carbon, and brass disc, and the whole was secured in a small convenient flat wooden case. The carbon powder was preferably oven-made engine coke, and it was an essential feature that it should be in a loose free state. The only difference, indeed, between this transmitter and Edison's is the looseness of the carbon, which made it an agglomeration of microphone contacts.

The present improved form is mainly due to Mr. Cox-Walker, of York. It was recently exhibited at a meeting of the Cleveland Institution of Engineers, Middlesborough, with every success.

Its outward appearance is similar to that of the ordinary Bell telephone, which is now so familiar to nearly everyone, but the resemblance stops there. The usual telephone mouthpiece is covered on the under side of the opening by a piece of nickel-plated brass wire gauze, which forms a protection to the thin sheet of platinum foil, which now acts the part of a vibrating diaphragm, and is in immediate contact with a very thin layer of granulated coke, which fills a small posterior cavity, provided with a brass plate at the bottom. The platinum foil is connected to one terminal through a brass ring, and the brass plate is connected to the other terminal. The terminal wires are passed through a hole down the centre of the handle, the latter being screwed on to the central part.

In connecting it up for use a receiving telephone (which may be Bell's or other similar instrument) is, of course, required at each end of the line in addition to the micro-telephone transmitter, and also a battery of Leclanché or other cells. The office of this transmitter is, by the aid of the battery current, so to increase the sound given out by the receiving telephone as to make these instruments a practical success, and also to overcome by its power the effects of induction from neighbouring wires, this latter having hitherto prevented the use of telephones on wires in the neighbourhood of others along which strong voltaic currents may be passing. The success of Hunnings' micro-telephone in this respect is undoubted, and its clear articulation and power are very striking. The loose granulated coke between the two metallic plates is the secret of this success. The aerial waves cause more or less of the under surface of the diaphragm to come into contact with the grains of coke, at the same time causing these particles to press more closely upon each other, thus decreasing the amount of the resistance they offer to the passage of the voltaic current through them by bringing more points into contact with each other, this action taking place in a greater or less degree in accord with the amplitude of the vibrations of the platinum foil acting under the influence of the sonorous waves. The control which this movement of foil and coke grains exercises over the passing current renders the use of an induction coil, which is found to be so great a necessity with other forms of telephone transmitters—Edison's, Crossley's, and Blake's, to wit—quite unnecessary; and by the use of a special form of receiver, which is now engaging the attention of Messrs. Hunnings and Cox-Walker, the effects of induction are hoped to be entirely eliminated, the experiments hitherto made by them in this direction giving promise of ultimate success.

An automatic switch board, with call bell and ringing key, completes the outfit for each end of a line for telephonic purposes.

The instruments were successfully tried not long ago between York and Darlington, a distance of about forty-five miles, the wire used for the purpose of this test trial being one of about twenty of the ordinary telegraph wires which stretch from pole

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to pole along the side of the railway. The effects of induction were at times very powerful, but they did not prevent the easy and successful carrying on of conversation or the transmission of ordinary railway cypher messages between the two stations. The instruments exhibited at the meeting were connected on to the private wire of Messrs. Stevenson, Jacques, and Co., to their Acklam Works, where a set of similar instruments were placed. Conversation was then carried on for a considerable time with the Acklam office.

The microphone transmitter of Mr. L. J. Crossley is too well-known to require description here; but that gentleman has recently supplemented it by a new receiver which is an ingenious modification of Bell's. An electro-magnet of a square horse-shoe form has both poles presented to the underside of the diaphragm. One pole only is surrounded with a bobbin of insulated wire. The internal cavity is filled up with paraffin wax after the poles are adjusted by means of a screw to the proper distance from the diaphragm. This is to render the tone purer. The current is circulated through the bobbin, and the diaphragm is correspondingly attracted.

Another form is made having two of these electro-magnets side by side, acting on the diaphragm. The loudness of the sounds depends, of course, on the strength of the current; but six Leclanché elements give good results on a line nine miles long, when using the Crossley microphone for a transmitter.

At a recent meeting of the Royal Society a paper was read by Mr. Preece on some thermal effects of electric currents, in which he showed that extremely fine wires acquire and lose heat so rapidly, and are so sensitive to expansion from the heating, that, if inserted in the circuit of a microphone transmitter, they reproduce sonorous vibrations. Thus a mere sounding board or disc, and a fine wire, are all that are needed to reproduce speech with the same faithfulness that Bell obtains by electro-magnetic agency, Edison by electro-chemical agency, and Hughes by his microphonic principle.

A similar telephone has also been invented by M. Ader and Count du Moncel, and it will be remembered by our readers that at a recent meeting of the Society of Telegraph Engineers Professor W. E. Ayrton announced that he had just heard in Paris a remarkably simple telephone receiver, consisting merely of very fine copper wire bent into a curved form. If we remember rightly Count du Moncel had shown Professer Ayrton this receiver, and its principle would seem to be identical with that of Mr. Preece.

M. Ader has done some excellent work in telephony of late. The wire receiver is the natural outcome of his first telephone patented in this country last year. In this instrument a bar of iron was loosely encircled with a coil of wire, through which the vocal current flowed, and the molecular expansion and contractions of the bar gave out sound without a diaphragm. The next advance he has made is to dispense even with the bar, and make the thermal expansions and contractions of the wire itself give out sound under the action of the current.

Another form of telephone receiver was brought before the French Academy very recently by M. Ader. It is based on the principle that if a thin plate of iron or steel is placed before the poles of a magnet, it is much more strongly acted on by the poles when a second plate or armature of iron is placed behind it than when that second plate does not exist. This is easily proved by holding a spring in front of a horse-shoe magnet with its poles close together, so as to be attracted, but not sufficiently so to touch the poles. Then, on bringing up the armature behind, the spring will fly inwards to the poles.

The new telephone consists of a Bell receiver with a horse-shoe magnet and an iron diaphragm. Behind this diaphragm a second disc is fixed, having a hole perforated in its centre so as to permit the vibrating air to reach the inner disc. This telephone, through the exalting action of the rear disc, gives louder results than the ordinary Bell instrument.

HOW TO MEASURE THE SIZE OF WIRES.

By M. Rothen, Assistant Director of Swiss Telegraphs.

(Translated from the *Journal Télégraphique.*)

At first sight this question seems so simple that many readers might think that they could answer it at once. Yet it has already been productive of many discussions, propositions, and counter propositions within the last twenty years; and, quite recently, a committee formed of names distinguished in applied science was appointed to investigate it. The reason why the mode of indicating the size of wires is not so simple as it appears is that some wish to determine it by a line and others by a surface, in other words, some would take the *diameter* and others the *weight* as a basis of measurement. On the European continent the first method predominates; whilst in England, in the United States, and in the British colonies the second has been almost exclusively adopted. A consequence of this diversity is that the question considered in the present article receives very different solutions according to locality; each naturally regarding its own as the only rational and possible one.

We will endeavour to examine the two systems of measurement as impartially as possible, to sum up their advantages and disadvantages, and thus to arrive at a duly-considered answer to the question.

To measure the thickness of wires according to their diameter is a method the principle of which is so simple as to need no explanation. For this determination the diameter is indicated in millimetres and fractions of the millimetre, including tenths or tenths and hundredths. Thus we say a wire of 3, 4 or 5 mm., and, in the case of thin wires, of ·1, ·05 &c. mm. The diameter suffices to indicate with precision, both to the manufacturer and to the purchaser, any particular size of wire.

It is altogether different with the other method. There numbers are almost indispensable to distinguish the different wires, and each number corresponds to a certain weight of wire in a given length. In this system of measurement the best known gauge is the "Birmingham wire gauge." It is of great antiquity, and its origin, as well in respect to date, as in regard to the principles on which it was established, is unknown. In 1735 it was already in use, and at the present time there are in existence some standards which date from the last years of the past century. Gradually the original gauge became slightly modified in the hands of the manufacturers of the standards, so that there are now a great variety of gauges, all taking the denomination of B.W.G., but differing from each other, more or less, in the case of several numbers. Each manufacturer considers his gauge to be the true Birmingham gauge; but it is impossible to ascertain which is the true original one. Besides the Birmingham gauge, a number of others have been devised, generally with a view to remedy the defects of the B.W.G. These gauges, which ordinarily bear the names of their inventors, or of persons who have adopted them, differ from each other and from the B.W.G. in a still more marked degree. It is easy to understand that such a number of different gauges is productive of great inconvenience in commerce, to the seller as well as to the purchaser.

The standard which serves to measure wires according to the Birmingham numbers is generally a plate of steel having rectangular notches, which are numbered. Sometimes these notches form an angle ending in a circular hole. The wire which fits exactly into the notch, or which can pass from the notch into the hole, bears the number indicated at that portion of the standard. Other standards are formed of two plates of steel forming a very acute angle. The number is indicated by the point to which the wire can penetrate into the angle. Until 1846 these standards were the only means employed to indicate the sizes of wires. But the standard becomes worn as in the case of a screw tap or of a die hole; and the measurements then become inaccurate, even assuming them to have been otherwise when the standard was new. This circumstance suggested to M. Holtzapfel in 1846 the idea of determining the different numbers of the B. W. G. in thousandths of the inch. His numbers are from 0000 to 36; the corresponding diameters are as follow:—

Numbers.	Thousandths of an inch (mils.).	Numbers.	Thousandths of an inch (mils.).
0000	454	17	58
000	425	18	49
00	380	19	42
0	340	20	35
1	300	21	32
2	284	22	28
3	259	23	25
4	238	24	22
5	220	25	20
6	203	26	18
7	180	27	16
8	165	28	14
9	148	29	13
10	134	30	12
11	120	31	10
12	109	32	9
13	95	33	8
14	83	34	7
15	72	35	5
16	65	36	4

This system of determining the number of a gauge by the diameter in mils. removes, it is true, any uncertainty; but it has the drawback of necessitating a double indication of the size of a wire. The purchaser is required to specify, for instance, that he requires No 8 wire, having the diam. 165 mils. Now, the indication

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both of the number and of the diameter should not be necessary; the retention of the two systems of measurement is in commerce a complication. In the present state of things, the number alone is insufficient, as may be seen by taking one of the numbers of the B.W.G., for instance No 9, of which the diameter in mils. is as follows, according the different authorities :—

Cocker	140	Bartholomew	150
Culley	143	Warrington	155
Rylands	146	Schaw	156·2
Holtzapfel	148	Molesworth	158

The other numbers of the B.W.G. are subject to similar differences. It follows that, with a view to accuracy, the specification of the diameter should be added to that of the number, as is now the general custom in England and wherever the B.W.G. is employed. But why should not the number be altogether dropped if it allows of uncertainty in respect to the size of the wire? Before going into this question, we will endeavour to account for the peculiarities of the Birmingham gauge.

We have already stated that the true gauge is lost, or, if it be still in existence, we cannot say which of the present gauges is the original one. Still it may be admitted that the Holtzapfel gauge, for instance, does not differ from the true gauge to such an extent that the principles which guided the inventor of the latter may not be inferred from it. It will be observed in the first place that the finer the wire the smaller is the difference between the diameters of two consecutive wires; but it is very difficult to discover any system in the irregularity with which this diminution takes place, and in the present day, after numerous researches, although it is considered that the principle followed has very probably been discovered, there is no absolute certainty in the matter. The wires may have been numbered according to the number of drawings they had undergone. The hammered rod was called No. 0; after its passage through the first hole it was called No. 1; after passing through a second smaller hole, No. 2, and so on. The manufacturer always has a tendency to make the difference between two consecutive holes as great as the material to be drawn will allow; and the natural result of this was that in the case of fine wires the difference between two consecutive numbers was smaller than in the case of fine wires. The conclusion from all this is that the B.W.G. is not based upon any scientific principle, and that, on the contrary, it is empirical, arbitrary, and, what is worse, irregular. The irregularity strikes the eye at once if the series of numbers be represented by a curve of which the diameters of the wires are the ordinates and the numbers the abscisses.

These details show clearly that a correction, either in one direction or the other, is of urgent necessity, especially if it is desired that the B.W.G. should be adopted throughout the whole world and not merely by the English and by English-speaking countries. But here another obstacle to the general adoption of this gauge presents itself, viz.—the adoption of the British measures. A gauge based upon the English pound and inch would be a still-born child. Never would the nations who do not speak English adopt it, for these measures are condemned to disappear before the metrical measures. The British Association for the Advancement of Science, which, in 1863 and 1864, established an absolute standard of electrical resistance, was thoroughly imbued with the truth of this statement, since it adopted as the basis for its researches the *metre* and the *gramme*, although these measures were then even less familiar to the English than they are at the present day.

(TO BE CONTINUED.)

ATLANTIC TELEGRAPHY.

Two or three weeks ago we received a copy of the *New York Evening Mail*, containing the account of a reporter's visit to Mr. G. G. Ward, superintendent of the Direct United States Cable. The interview elicited opinions specially worth attention at this time as follows :—

Q. One or two of our New York daily papers have contained some hints that the recent break in the French cable was done maliciously. Is there, in your opinion, any foundation for such a suggestion?—A. To that I should say that the supposition is absurd. The direct cable has been broken no less than eight times since it was laid in 1875, and in nearly every instance it has been broken by the anchors of fishing vessels. The company, finding this to be the cause, have circulated notices to captains of these fishing vessels that they will pay for their anchors, providing the captains will cut them away and not injure the cable.

Q. Do you know whether the new French cable is laid in the vicinity of the fishing banks?—A. I believe it is laid directly across the Great Bank of Newfoundland.

WHERE THE FRENCH CABLE IS BROKEN.

Q. Do you know whether it has been decided where the French cable has been broken?—A. I have been told that it is not far from St. Pierre. Over the Great Bank of Newfoundland, the deepest water is 64 fathoms, while the shallowest is but 35 fathoms. It is well known that hundreds of vessels, each of which carries from 150 to 200 fathoms of anchor cable, drop their anchors and fish on this bank during the whole summer. Upwards of 200 French vessels are fitted out every year in the early part of April at St. Pierre alone, to fish on this bank.

Q. The old French cable which was laid in 1869, was that in the same vicinity? A. That cable was laid just outside the bank which suddenly descends from 130 to 450 fathoms.

Q. Has that cable ever been broken? A. It has been broken two or three times, but never in this depth of water.

Q. Are there not a good many icebergs in this locality, especially at this season of the year?—A. Yes. A large number, and the new cable—if it is laid across the Great Bank—would be directly in the line of these icebergs.

Q. What would be the effect of these icebergs upon this cable?—A. The effect would undoubtedly be to crush the cable. It is only three years ago the whole of the Anglo-American cables were broken by an iceberg which was actually seen by the cable operators to move directly across the cables, and, at the same time the electric current ceased.

Q. How far does the Great Bank of Newfoundland extend east of St. Pierre?—A. Some two or three hundred miles.

Q. Was not this new French cable completed the day before it broke?—A. No, this cable was completed last November, and it was only the connection between France and England that was finished the day before it failed.

THE NEW CABLE COMPANY IMPRACTICABLE.

Q. I have as yet seen no mention of any proposition on the part of the New York Land and Ocean Telegraph Company to lay more than one cable. What would be your opinion, in such an event, as to the success or failure of the enterprise?—A. I think it would fail, for the reason that business stops with the breakage of a cable. The Direct Company made an arrangement with the Anglo-American Company for the very purpose of giving them more than one cable. The Direct Company were in the same position as the present French Company until they made this agreement.

Q. The cable despatches a short time ago stated that the French Company were negotiating to pool with the old companies. Do you know if that statement is true?—A. I am informed that it is correct, and that they wished to make a pooling agreement based on the present tariff, viz., seventy-five cents. per word. In fact, they never intended, judging from their original prospectus, making the rate any lower until they found that no agreement could be entered into with the old companies.

Q. What have you to say as to the statement that your company is controlled by the Anglo-American?—A. We are certainly not. We are entirely distinct and merely have an agreement as to earnings similar to that existing between railroad and express companies.

Q. What is the scope and probable effect of the Canadian Marine Telegraph Act of 1875? A. It is said that this act was passed to encourage competition, but, in the opinion of many, the effect will be directly the opposite of that. That act was passed after the Direct cable was laid, and it states that no company shall make any arrangement with any other company that has exclusive rights. The Anglo-American Company having exclusive rights in Newfoundland, and the Direct Company having made an agreement with them, the Canadians argue that the Direct Company have violated their law and they have the power to turn the Direct Company from their shores. If the Canadian Government should insist upon the exact interpretation of this law it would certainly destroy its spirit, as it would simply leave the French Company with a monopoly of Canada. There is, however, one point which has not as yet been elucidated, and that is, that at its best the Canadian Act is clearly inoperative; as, in the event of any working or traffic arrangement being entered into between the French and English companies, to put this Act into force would be to leave Canada entirely without a cable connection.

CHEAPER CABLING IMPRACTICABLE.

Q. What is your opinion in regard to the proposed effort to introduce cheap ocean telegraphing under the name of the New York Land and Ocean Telegraph Company?—A. I am certain it will never succeed, because, at the rate they propose to charge, the enterprise will never pay them per cent. on their capital. The capacity of a cable is limited, and the new company cannot possibly send a sufficient number of words upon a single cable, if it was full every twenty-four hours, to pay them a dividend at 25

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cents per word—the tariff proposed. Independent of this, they can never be a success without a second cable. Then, again, there is not a living for another company, as the present ones are only paying a dividend of 5 per cent., which cannot be considered extravagant, considering the risk they run of breakages and sink their capital at the bottom of the sea.

A CABLE'S LIFE.

Not only that, but experience has shown that the life of a cable is from ten to twelve years. If a cable breaks in deep water after it is ten years of age, it cannot be lifted for repairs, as it will break of its own weight; and cable companies are compelled to put aside a large reserve fund in order that they may be prepared to replace their cables every ten years. The action of the sea water eats the iron wire completely away, and it crumbles to dust, while the core of the cable may be perfect. The breakages of cables are very costly, and it is a very difficult matter to repair them, in comparison with a land line. A ship has to be chartered at an expense of 500 dollars a day for two or three weeks in fixing the locality and in avoiding rough weather, as cables can only be repaired in the calmest seasons. One break alone in the Direct Company's cable cost them 100,000 dollars to repair, and the last chance left to the company was to make an agreement with the Anglo-American so that they should be protected and have the use of that company's line when their own was stopped.

LITERATURE.

We are compelled to leave till our next issue a preliminary notice of "A Physical Treatise on Electricity and Magnetism," 2 vols, by J. E. H. Gordon, B.A. (Sampson Low and Co.), which we have in type.

ABSTRACT OF PATENTS.

3927. GALVANO-PLASTIC PROCESS, *W. E. Gedge.—Dated 30th September* 1879.—(*A communication.*) 6*d.*

This consists in the jointing of the anode and its arrangement in the form of a chain, which permits its being easily introduced into, and withdrawn from, the mould, to follow or ascertain the course or progress of the operation, and taking naturally or of itself the form of the mould, filling the whole of the cavity and following the principal sinuosities.

3931. CALL OR SIGNALLING APPARATUS EMPLOYED IN CONNECTION WITH TELEPHONES, &c., *J. H. Johnson.—Dated 30th September*, 1879. (*A communication.*) 6*d.*

This relates to an electric or telephone signal, having a disc or other device connected with a vibratory plate or strip, and adapted to be operated by successive vibrations of the said plate or strip.

3943. GALVANIC GENERATORS, *A. Gutensohn.—Dated 1st October*, 1879. 6*d.*

This consists in the use and employment of sulphate, nitrate, chloride, or chromate of tin in those batteries wherein zinc is most advantageously employed.

3959. MEDICO-GALVANIC ELECTRODE, *J. L. Pulvermacher. Dated 2nd Oct.*, 1879.—*(Not proceeded with).* 2*d.*

Triangular thin copper and zinc plates of the form of segments of a circle are fixed in alternate order on one or more superposed circular discs of stiff cotton, linen, or woollen cloth, or other suitable material.

4087. MANUFACTURE OF ALUMINIUM AND MAGNESIUM, *J. H. Johnson. —Dated 9th October*, 1879.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

This relates to the manufacture of aluminium and magnesium by the employment of dynamo-electric machines.

4170. INTERLOCKING THE TELEGRAPHIC BLOCK INSTRUMENTS WITH THE POINTS AND SIGNALS OF RAILWAYS, *C. Hodgson.—Dated 15th October*, 1879. 6*d.*

The apparatus employed consists of a locking handle, which can be moved by hand into either of two positions so as to lock and unlock the point and signal levers; Secondly, a commutator with its plunger for making electrical connections and transmitting telegraphic signals to another station; and Thirdly, a detent which is connected to and worked either by one of the ordinary semaphore signals, or by a treadle or trigger acted on by a passing train, the connections for this purpose being either mechanical or electrical.

4189. ELECTRIC TELEGRAPH TERMINAL AND SHACKLE INSULATORS, *C. E. Crighton.—Dated 16th October*, 1879. 6*d.*

This consists in a terminal or shackle insulator, of the employment of an insulating hollow conical body enclosing a conducting rod or bolt for receiving the strain of the aerial wire, the said hollow conical body having alternate annular or surrounding recesses and projections for preventing the continuity of damp.

4298. TRANSMITTING AND RECEIVING SIGNALS ON SHIPS AND VESSELS, &c., *F. R. Francis.—Dated 22nd October*, 1879. 8*d.*

This consists in the combination and arrangement of an instrument containing a series of commutators or transmitting keys, in number corresponding to the signals employed in connection with insulated copper wires for communication between the officer on deck and the helmsman and engineer in charge of the engines, and arranged so that such key or commutator is capable of producing one signal only, and that each key when depressed causes the transmission of either a positive or negative current, and thereby giving instantly, and by means of electricity, orders and instructions for the navigation of the ship or vessel, and receiving replies and acknowledgments of such orders and instructions.

4306. AUTOMATIC CONTACT BREAKER FOR ELECTRIC CIRCUITS, *T. Wilkins.—Dated 22nd October*, 1879.—(*Not proceeded with.*) 2*d.*

This relates to a means whereby the circuit is broken and the current stopped automatically after a period of time more or less long.

4976. APPARATUS FOR EFFECTING TELEPHONIC COMMUNICATION, *J. Imray.—Dated 3rd December*, 1879.—(*A communication.*)—(*Complete.*) 6*d.*

At each station is a circular table with a number of interrupters or contact makers or breakers distributed over its service. The table occupies a central position in a circular compartment, and round it are arranged a number of seats beside a table, under which are suitable batteries and induction coils, and above which is a tablet presenting a number of contact makers. By inserting in the holes of any two of the interrupters pins electrically connected together, telephonic communication may be established between any two subscribers.

5004. TELEPHONES, *J. Imray. Dated 6th December*, 1879.—(*A communication.*)—(*Complete.*) 4*d.*

A permanent magnet of horseshoe form has one limb bent, so as nearly to cross the gap between it and the other limb. An electromagnet is fixed on the bent limb, and the diaphragm is secured in a case of non-conducting material. The conducting wires covered with insulating material are passed through holes in the free limb of the magnet, and are secured at their ends by the contact screws. Two lengths of wire may be connected by a union consisting of a socket with a screwed mouth to receive a gland, in which a helical wire is inserted. The wire is held in the gland by a screw, whose thread engages with the helical wire. By screwing up the gland the screw head is pressed against the bottom of the socket, completing electrical connection.

5009. FRICTION TELEPHONES OR ELECTRO-MOTOGRAPHS, *J. Imray.—Dated 6th December*, 1879.—(*A communication.*)—(*Complete.*) 6*d.*

A cylinder of compressed chalk is soaked in an electrolytic solution, such as caustic alkali, to give conductivity. The axis of the cylinder is connected by gearing to an axis with a handle, by turning which the cylinder is rotated. On the periphery of the cylinder a blade attached to the diaphragm is pressed by a piece of wire acted on by a spring. The line wire is attached to the blade and the axis of the cylinder is connected to the earth. A pivotted lever carries a roller at one end which dips into a water reservoir, and the other end of the lever can be moved downwards, so as to raise the roller in contact with the cylinder and so moisten the latter.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 16.		Business Done Week Ending June 16. Highest.		Lowest.	
Anglo-American Ordinary	60,	½	60⅞		59⅞	
Do. "B"	90½,	¾	91		90½	
Do. "A"	33,	½	33¾		32¾	
Brazilian	8 7-16,	9-16	8½		8⅜	
Cuba	9¼,	¾	9⅝		9¼	
Do. Ten per Cent. Pref.	15½,	16½	15½		15½	
Direct Spanish	1⅞,	2¼	—		—	
Do. Ten per Cent. Preference	10⅞,	11⅛	—		—	
Direct United States	10⅞,	11⅛	11⅛		11⅛	
Eastern	8⅞,	9	9		8⅞	
Do. Six per Cent. Debenture	103,	105	103		103	
Do. Five per Cent. do.	103,	105	103¾		103¼	
Do. Six p Ct. Preference	12⅛,	⅜	12¼		12	
Eastern Extension	9	⅛	9 3-16		9	
Do. Six per Cent. Deb.	107,	110	—		—	
German Union	8½,	9	—		—	
Globe Telegraph & Trust	5⅞,	6	6		5⅞	
Do. Six p Ct. Preference	11⅞,	12	12		11⅞	
Great Northern	9⅝,	⅞	9 13-16		9¾	
Indo-European	22,	23	—		—	
Mediterranean Extension	2¾,	3¼	—		—	
Do. Eight per Cent. Preference	10½,	11	10⅝		10⅝	
Reuter's	9½,	10½	—		—	
Submarine	235,	245	241		241	
West India and Panama	1¼,	½	1⅜		1 3-16	
Do. Six per Cent. Preference	7½,	½	7½		7½	
Western and Brazilian	6 13-16,	15-16	7⅝		6¾	
West. Union 7 p. Ct. 1st Mt.	117,	122	—		—	
Do. Six per Ct. Sterg.	103,	105	102½		102½	

TRAFFIC RECEIPTS FOR MAY, 1880.

Companies.	May, 1880.	May, 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,900 estd.	3,108	—	208
Direct Spanish Telegraph Company	1,334 estd.	984	350	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,963	38,371	4,592	—
Eastern Extension Telegraph Company	26,570	25,845	725	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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SLIP

EASTERN TELEGRAPH COMPANY.—The next meeting of this company will be held on the 15th day of July.

SOUTH INDIAN RAILWAY.—The telegraph receipts for 1878 were £2,242, in 1879 £2,133, or a decrease of £109.

RUSSIAN TELEGRAPHY—It appears from an official report that at the commencement of 1879 Russia possessed 93,690 versts of telegraph and 2,516 telegraph offices. Of the Russian telegraphic network no less than 70,356 versts were in the hands of the Government in January, 1879.

STRUCK BY LIGHTNING WHILE UNDER WATER.—At Halifax, N.S., May 29, while divers were at work at Cole Harbour Dike, a storm came upon them, and the lightning striking an air-pump, passed down to a diver under the water. When brought up he was insensible, but his injuries are not serious.

WELLINGTON, NEW ZEALAND.—The *Builder*, in its issue of last week, illustrates the design for the Post and Telegraph Buildings in Wellington, which is about to be carried out. It is a competitive design, and was sent in by Messrs. Mason and Wales, architects, of Wellington. The principal front will face Custom House Quay.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—FURTHER REDUCTION OF TARIFF "*viâ* DIRECT CABLE."—From the 19th June and until further notice the tariff for telegrams "*viâ* Direct Cable" between Great Britain or Ireland and New York and Canada has been reduced from 2s. to 1s. 6d. per word. The rules applied to messages prior to and since 1st April, 1880, remain unaltered.

ANGLO-DUTCH TELEGRAMS.—In accordance with an agreement entered into on May 27 last between the British and Belgian Governments in respect of Anglo-Dutch telegrams transmitted over Belgium, telegrams exchanged between Great Britain and Ireland and the Netherlands, when passing by the telegraphic lines of Belgium, shall be subject to a transit charge of 5 centimes per word, to be placed to the credit of the latter country.

THE VOLTA PRIZE.—This prize, instituted in 1852 for the purpose of rewarding the most important applications of the voltaic battery, has this year been awarded by a committee under the presidency of M. Dumas to Alexander Graham Bell for his invention of an articulating magneto-electric telephone. The prize in question consists of the sum of 50,000fr. A second prize of 20,000 has been awarded to M. Gramme, for his magneto-electric machine. The Volta prize was awarded for the first time to M. Ruhmkorff, in 1864, for various apparatus of great service in industrial applications.

ELECTRO-BRASS PLATING.—According to the *Chem. Soc. Jnl.* M. J. J. Heoz uses the following bath, which differs materially from former formulæ:—84 grams sodium bicarbonate, 54 grains ammonium chloride, and 13 grams potassium cyanide are dissolved in 2 litres of water. To render the bath active the sides of the vessel are covered with a sheet of brass, which serves as anode, whilst another piece of brass hangs in the bath and forms the cathode. The current is allowed to pass through the bath for one hour, when it is ready for use. It is better to employ cast brass. In order to tin directly on zinc the author uses the following mixture:—50 grams sodium phosphate, 50 grams salammoniac, 25 grams sodium bicarbonate, and 25 grams tin salt dissolved in 1 litre of water. Instead of sodium phosphate Rochelle salt may be employed.

TELEGRAPHIC COMMUNICATION WITH GERMANY.—On June 17th a Parliamentary paper was printed, containing an agreement between the Governments of Great Britain, Germany, Belgium, and the Netherlands, fixing the rates for telegraphic messages between Great Britain and Germany, which agreement was signed at London on the 31st of May, 1880. Article 1 provides that "the charge for ordinary telegrams exchanged between Great Britain and Ireland and Germany, by the direct route or *viâ* Belgium or *viâ* the Netherlands, shall be fixed uniformly at 30 centimes a word." The charges to be collected in this country may be rounded to suit monetary conveniences, but so that the rate collected for a telegram of fifteen words shall not exceed 4f. 50c. by more than 30 centimes. Article 2 regulates the amounts to be paid to each of the countries parties to the agreement. Under Article 5 the agreement came into force on the 1st of the present month.

EDISON'S MAGNETIC ORE-SEPARATOR.—At Washington, on June 1, Thomas A. Edison, of Menlo Park, N.J., was granted a patent for a magnetic ore-separator, which allows magnetic and non-magnetic substances to fall together, and then, by magnetic attraction, alters or changes the trajectory of the falling magnetic substance without stopping its fall. From a diagram in the *Scientific American* we gather some idea of the extreme simplicity of this machine, about the utility of which experience will have to decide. Take the top of a turnip-cutter, make the lower opening small, and place upon an open frame. Upon a cross piece joining two sides of the frame fix an electro-magnet, the arms of which reach near to the vertical line below the hopper opening. The magnetic attraction changes the trajectory of the falling magnetic sand without stopping its fall, so that while the silicious sand, gold, and other non-magnetic substances fall straight down into one compartment of the receiving hopper, the trajectory of the magnetic sand is changed so that it falls into another compartment of the receiving hopper. By this means the separation of the black sand is rapidly and completely effected with the expenditure of very little labour.

FRENCH PHYSICAL SOCIETY.—At the meeting of May 21, M. Bouty described, on behalf of M. Righi, an experiment exhibiting "residual magnetism" of polarity opposite to that which prevailed during temporary magnetisation. The phenomenon in this case was shown in a steel bar 5 centimetres in length by 3 in diam., magnetised within a coil 5 centimetres in diam. by means of the current from three Bunsen cells.—M. Mascart described various arrangements employed for recording the indications of Thomson's electrometer. When the deflections are not proportionate to the differences of potential, the recorded indications may be made so by mounting upon a wheel, constructed with a spiral groove, the thread attached to the recording pencil.—M. Pellat announced that, in his experiments on contact electricity, an electromotive force very high as compared with the thermo-electric effect was obtained by employing two plates of the same metal at different temperatures.—M. Hospitalier compared the different modes of mounting employed in exciting the inductor of machines for the electric light; by far the most advantageous is that of Wheatstone, in which the inductor forms a derivation in the circuit. M. Siemens has made some conclusive experiments on this subject.—M. Bertin expounded at considerable length the theory of the so-called magic mirrors of Japan.

THE POSTAL TELEGRAPH ACT.—Henry Burton, lately a clerk in the telegraph department of the Post Office, was tried at Dublin on Friday for disclosing the contents of a telegram on the 17th of May last. The prosecution was brought under the 20th section of the Postal Telegraph Act of 1868, which makes the offence a misdemeanour punishable

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by imprisonment for a term not exceeding 12 months. The prisoner was detected under suspicious circumstances. At the conference of Irish members held on Whit Monday in the City Hall, Dublin, Mr. St. John Brenon was listening to one of the speakers, when he was accosted by the prisoner, who mistook him for Mr. Healy, who was then put forward as a candidate for the county Meath. The prisoner informed him that Mr. Fay, M.P., was putting up another candidate against him, and told him the contents of a telegram which he had sent himself in Mr. Fay's name to his brother in Trim. The prisoner stated that he was employed in the telegraph office, and that the reason for making the communication was that he was a Parnellite. Mr. Brenon reported the fact to the postal authorities, and was thus bound to prosecute. On the part of the prisoner it was contended that the contents of the telegram having been only disclosed to the sender there was no disclosure which would make the prisoner liable to punishment under the Act. The Court, however, overruled the point. The prisoner was found guilty, and sentenced to two months' imprisonment with hard labour.

Money Order Telegrams.—A system of telegraph money orders was commenced in New Zealand on the 15th June, 1871, and the Postmaster-General for that colony reported on the 14th August of the same year that it had already proved highly successful. In the twentieth annual report of the Postmaster-General, dated Wellington, 18th July, 1879, it is stated that during the year 1878 the telegraph had been used for the transmission of 13,228 orders, amounting to £54,807 10s. 6d. In the previous year, 12,478 orders for £55,683 were sent by wire. The Commissioner of Telegraphs, whose report is for the year ended the 30th June, 1879, writes as follows:—"The number of money order telegrams sent during the year was 14,607, representing a value of £61,693 9s., being an increase over the previous year in messages of 1,807, and value of £6,770 18s. 7d. The commission collected by the Post-office on these transactions amounts to £1,758 9s. 4d. From this amount has to be deducted the sum of £730 7s. as fees on telegrams, which leaves £1,028 2s. 4d. to the credit of the Post-office, which is equal to 1,666 per cent. upon the total amount transmitted. Wellington stands first as having issued the largest number of orders, Christchurch, Auckland, and Dunedin coming next in the order mentioned as regards the number issued, although the money value of the orders issued by Dunedin exceeds that of Auckland by £750 3s. It is satisfactory to note that this convenient method of transmitting money rapidly at a small cost is steadily increasing in public favour."

Western and Brazilian Telegraph.—The profits of the past half year ending March 31, 1880, are, as stated in the report, £15,993, and these are *net* profits. The profits on working are £30,735. Deducting the interest on debentures £9,891, rebate £322, stamps for new debentures £562, and balance of cable repairs £3,967, in all £14,742, the sum remains of £15,993. The half year's gross revenue is £62,209, a half of which is profit, and a quarter net profit. Had not the extraordinary expenses named occurred the net profits would have been nearly £5,000 more, or between £19,000 and £20,000 instead of £15,993. Moreover, a good deal may presently be saved in the hire of the International, which last half year cost £11,422. As the share capital amounts to £1,398,200 the net profits of £15,993 would have sufficed to pay 1 per cent. for the half year, at the rate of 2 per cent. per annum, with a balance over. The concern is improving. During the half year the traffic has increased by £20,521, and the directors report that the prospects of the Company as regards both the traffic and the expenses have improved. The heavy renewals are drawing to a close, but the Company will, doubless, commence the formation of a renewal fund out of revenue. The Company will not divide up to the last pound. It is evident, therefore, that to do much good the traffic must increase, or rather continue to increase, somewhat considerably. The whole capital, including debentures, is about $1\frac{3}{4}$ million pounds. £62,000 gross revenue in a half year is not enough for prosperity. There is, however, under the present vigorous management, every probability that the traffic will be greatly developed.

Violent Thunderstorms.—Shortly after one o'clock on Saturday afternoon a severe thunderstorm passed over Barnsley and did serious damage to the house occupied by Mr. A. Senior, brewer, Mount Osborne. A very vivid flash of lightning was followed by a heavy peal of thunder, and immediately a large blue ball was noticed to descend and strike the house of Mr. Senior, destroying the chimney-stack, passing through the roof, and entering the billiard room, where it did a good deal of damage. The chimney pots and stones fell and passed through the roof of the bath room, which is over the kitchen, the chimney of which was swept with remarkable quickness. Two servants who were getting dinner in the kitchen near the fireplace were greatly alarmed and beat a hasty retreat. The kitchen was covered with soot and considerable consternation prevailed, but fortunately no one was injured. Several workmen from the Oakwell Brewery were called in and covered the roof with tarpaulin. A severe storm of thunder and lightning passed over Bath and the neighbourhood. At Batheston, a suburban village, three bullocks and a horse were killed by the lightning, and much other damage was done by the electric fluid. A terrific hailstorm, accompanied by thunder and lightning, passed over Holbeach on Saturday. The windows of most of the houses in the district are smashed by the hailstones, and the crops have been levelled to the ground. In many of the fields the tops of the plants are cut off as with a scythe, and the farmers generally have suffered much damage to their crops. These are but one or two of the numerous cases which have been recorded in local papers during the past week. Is it not singular that a nation priding itself—falsely, as we think—on its practical characteristics, does not generally protect its dwelling-places from accident by lightning. We should like to tie Mr. Anderson's book on "Lightning Conductors" round the neck of every builder and compel him to follow the guidance therein given as to the effective precautions to be taken against lightning.

The Electric Light.—In a report to Sir E. Thornton, Mr. V. Drummond, of the Washington Legation, says:—"Mr. Edison's electric light cannot be said to have reached the successful point intended; the trials are not, however, yet finished; when they are the results will be more clearly proved. The Brush electric light, however, seems to be successful for manufacturing purposes, as will be noticed from the following:—The electric light is coming into extensive use for a great variety of manufacturing purposes. The Telegraph Supply Company of Cleveland, O., report that they have sold over 1,000 Brush (electric) lights for use in rolling mills, machine shops, factories, and similar uses, displacing over 20,000 gas burners. One of the mills—the Riverside Worsted Mills of Providence—has used this light for nearly a year with excellent results. The managers, speaking of the success of the experiment, say 'that the lights could not have a severer test than we give them, as our

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mills run night and day the year through, and we have not had a moment's delay from, or a dollar's worth of repairs on, any of the machines or lamps. The light is all we expected; it is strong and steady, clear and white; it is universally liked by both overseers and helps; so much so that we doubt if we could get along now with the help if we were to return to the old gas lighting, certainly we should not get so good work, nor so much of it. We use ground glass globes pretty generally throughout the mill, and we have less complaint of trouble to the eyes than we used to have with gas. The air of the room, too, shows a very marked difference. With the electric light the air is as good as in the daytime, and noticeably cooler. We had formerly about 250 gas burners of 17 candle-power each, a total of 4,250 candle-power. We have now 20 electric lamps of 2,000 candle-power each, a total of 40,000 candle-power. Owing to some changes preparatory to setting up new machinery, all our 80 lamps are not at this moment in full service, but by actual count we have 71 lamps permanently placed, and these displace 578 gas burners; that is, there are 578 burners already placed that would be lighted were the electric lights stopped. Estimating these burners at 6ft. per hour, we should use 3,468 cubic feet of gas per hour, costing at 2 dollars per 1,000 cubic feet, 6 dollars 93c. per hour. The actual cost of the electric light is as follows:—The 71 lamps consume carbons, 80c.; power used for machines, 65c.; interest on cost of machines, say 13,000 dollars 30c.; men to run machines and lamps, 33c.; oil, wear and tear, &c., 3c. Total cost per hour, 2 dollars 30c., making a saving of 4 dollars 73c. per hour, and this saving, for the 3,000 hours the machines run in the year, is 14,190 dollars."

Induction Machines.—Static induction machines (like those of Holtz) and dynamo-electric machines are compared together at considerable length, and it is explained how the Holtz machine can produce a small quantity of electricity at a high potential if the prime conductor be insulated, whereas the continuous currents that can be produced are exceedingly small. The author describes a static induction machine which he has constructed somewhat on the principle of putting a number of galvanic cells in parallel circuit. A horizontal axis carries a collection of little circular glass plates at small distances from one another. In alternate spaces between the revolving glass plates are placed well-insulated inductors, and in the spaces which are not filled there is a system of combs with their pointed ends turned in the direction of rotation. The two end glass plates are used as in the Holtz machine to increase the charge in the inductors while the remainder are employed to cause an electric current to flow into the combs and out through the wire attached to them. Using twenty glass plates, thirteen centimetres in radius, the whole, independently of the rotating mechanism, only occupying 0·05 cubic metres, and making twenty rotations per second, a current strong enough to work a Siemens polarised relay, and twenty times as strong as is obtainable with a Holtz machine, was produced. The best action of the machine was obtained by employing it to charge a battery of Leyden jars which were being constantly discharged by sparking. Charging eighteen great Leyden jars for 0·6 second, a spark was obtained which could heat five platinum wires. To work the machine continuously required the expenditure of four metre-kilogrammes of work per second, and the efficiency of the arrangement was about one-half. As this amount of work is less than one man can furnish, it is desirable to increase the number of glass plates and turn at a higher speed. Charging and discharging a large Leyden jar forty times a second, the discharge spark being one centimetre long, the noise was insufferable, the single sparks were indistinguishable, and a light of one to four candle-power was obtained. Three such induction machines being coupled together, and the battery of Leyden jars being discharged eight to ten times a second through a platinum wire 0·2 mm. in diameter, the wire remained permanently hot. The current could decompose water, but it required thirty-eight minutes to produce one cubic centimetre of explosive gas. The insulating cement employed in the construction of the induction machine deteriorates from use, so that it has to be regularly renewed.—Abstract of a paper *(Journal of the Society of Telegraph Engineers)*, by Herr Toepler, in *Electrotechnische Zeitschrift*, H. II., February, 1880, pp. 56-60.

Some Experiments with Small Batteries.—M. L. Baxter, M.D. writes to the *Scientific American* on this subject. He says: "To illustrate the capacity and sensitiveness of the telephone, I tried a small battery made in a common tumbler with a carbon and zinc pair, and a solution of ammonium muriate as an excitant. The common sal ammoniac will answer all purposes. This battery I included in a circuit with a Hughes microphone and a telephone; and instead of the monotonous ticking of a watch or clock, I used a musical watch with quite a range of tone. By the use of this watch the capacity of the microphone for transmitting high or low tones with their complementary overtones may be studied and regulated. With the battery above described I obtained all the tones clearly and well, and tried with it what effect different depths of immersion would have. One of the claims in Professor Bell's first patent on undulatory currents covers varying immersion as a means of varying the current, but I found very little difference in the operation of the telephone when the carbon plate was withdrawn so that nearly a corner touched the surface of the liquid in the battery. This led to the withdrawal of the zinc plate also, until only its corner touched the liquid. Under these circumstances the diminution in volume of sound was very slight, the tune coming out full and clear. The zinc plate being held clear of the solution a dead silence resulted, and the transition from this to full tone ensued with the slightest possible contact. These phenomena led me to construct very minute batteries, and the progress step by step was very interesting. One arrangement of a pair shows the battery in, to me, a new light. It is this: Make up a circuit of a microphone, a telephone, and a continuous copper wire, and, of course, there is silence in the telephone. Cut the copper wire, and to one of the ends attach a bit of zinc. Bring the ends together again and silence ensures as before; but allow the hundredth of an inch clear space to intervene and bridge the gap with a drop of battery solution, and the telephone at once finds its voice, not loud, to be sure, but clear and distinct for most of the notes. Such a 'battery' as this may be even concealed in the connecting wire by being covered by the usual cotton or silk insulating covering, two or three thicknesses of tissue paper between the ends preventing metallic contact. A gun cap battery with zinc and sulphuric acid gives a strong current for the microphone circuit. Discarding the zinc, as being too readily consumed, I have made pairs with carbon and gold, carbon and platinum, platinum and gold, &c., and in no case have I failed in getting results; but the currents are too weak for practical uses. Two pieces of carbon even have difference enough in their structure to determine a slight current appreciable by the telephone. The study of these combinations, though not of apparent importance, is interesting, and, where all are groping, may shed a ray of light upon something else."

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REPORT.

The war of the Atlantic Telegraph Companies continues. The most recent action in the combat is the reduction by the Direct United States Cable of the tariff from two shillings per word to one-and-sixpence per word. It is, of course, well understood by the public that the difference of rate of tariff between the Anglo-American and the Direct Company is to allow the latter to take special express messages. These two companies work under the joint purse arrangement which has proved so beneficial in cable work wherever and whenever it has been rightly adopted. The new French company, therefore, has to contend against rivals who are not only already in the field and have a large connection, but can arrange to fight the fight on their own lines, in their own manner, and on their own terms. The existing companies had sufficient cable power for a large increase of business, as is shown by the fact that they are able to transmit the increased number of messages at the lower rate.

Our contemporary the *Journal of Gas Lighting* is rather hard upon the Metropolitan Board of Works and the electric light on the Embankment. The animus, however, is too distinct; still, we do not blame a trade paper in looking at the experiment with slightly clouded eyes. There *is* nothing like leather. We are told that "the report of the Metropolitan Board of Works for 1879, recently issued, is wonderfully reticent concerning the proceedings of the Board respecting the installation and maintenance of the electric light upon the Victoria Embankment and Waterloo Bridge. The number of Jablochkoff lamps in use is stated, and the arrangements by which they are worked are detailed, but no hint of any kind is to be found of what the Board think of it all, or what their future proceedings in the matter are likely to be. It is stated that the experiments—which, by the way, are rather extended in point of time for "experiments"—have been undertaken by the Board with metropolitan funds for the general metropolitan advantage; but have the Board quite satisfied themselves that this extra illumination of the localities named is in all respects desirable? and, if so, is the system which they have patronised the best that can be obtained? We are not aware that the Board have attempted to try the expediency of any of the improved systems of gas lighting in the thoroughfares over which they hold the necessary control. While not grudging the Jablochkoff lamps their makeshift position on the Victoria Embankment—for variety is pleasing, and the twinkling carbons give, within brief intervals, every degree of illumination, from noonday blaze to soft twilight mystery—it would only be fair for the Board to try the new gas-lamps for a season; that is, if their steadiness and warmth of colour do not prove to be insuperable obstacles to their adoption." We notice, however, that the electric light is making friends in every direction, and there is no doubt it owes a great deal of its popularity to Dr. Siemens. The firm of Messrs. Siemens has provided the electric light for the Holyhead Harbour Works, just opened. The apparatus consists of a specially constructed engine to drive three dynamo-machines, each of which gives one light. The new docks at Silvertown, opened on Thursday last, are lighted by Messrs. Siemens on their system, and we hear that negotiations are being carried out to introduce the light in several other places.

The price of india rubber has a tendency downward. At auction 73 bales West India sort bought in at 2s. 3d. to 2s. 8d., 135 cases pressed Guayaquil at 2s. 6d., except 13 cases fine, which sold at 2s. 6½d.; 65 bales Chiltagong bought in at 2s. 1½d., and 5 bales African at 1s. 6d; 86 baskets of gutta percha were withdrawn. The quotations are:—Gutta-percha (genuine) 2s. to 3s. 6d., reboiled 3d. to 1s. 9d.; india rubber (Para, fine) 3s. 8d, negrohead 2s. 11½d., Central American 2s. 8d. to 2s. 11d., Assam and Pegu 1s. to 2s. 10d., other East Indian 1s. 10d. to 2s. 7d., Madagascar and Mozambique 2s. 2d. to 2s. 9d.

BRITISH GUIANA.—The local telegraphs transmitted during 1879 16,292 messages.

HOW TO MEASURE THE SIZE OF WIRES.

By M. ROTHEN, Assistant Director of Swiss Telegraphs.

(Translated from the *Journal Télégraphique*.)

(CONTINUED FROM PAGE 59.)

The idea of establishing a new gauge in which No. 1 wire should be of a certain weight, a, in English pounds per English mile, and in which the weights of the successive numbers should diminish regularly, does not seem to us a happy idea; for such a gauge would never be universally adopted, in spite of the real advantages it offers. On this principle is really based the gauge employed in British India, and a very slight consideration will enable us to bring into evidence these advantages.

The numbers are arranged in inverse order to that of the Birmingham gauge; that is to say, the thicker the wire the higher is the corresponding number. The No. 1 is a wire weighing 25lb. per mile; for the same length No. 2 weighs 50lb., No. 3 75lb., and so on; consequently No. n weighs $n \times 25$lb. per English mile. The weight of a wire of 1 inch diam. being known, the diameters corresponding to the various numbers can be readily calculated. Since the weight of an iron wire an inch in diam. would be 13833·6lb. per mile, the diameter of any wire $= \sqrt{\frac{\text{lb. per mile}}{13833{\cdot}6}}$ inch; and No. n wire has, consequently, the diameter $\sqrt{\frac{n{\cdot}25}{13833{\cdot}6}} = \frac{\sqrt{n}}{23{\cdot}5}$ inch. The sectional area is calculated with the same facility. It is expressed by $\frac{\pi d^2}{4} = \frac{\pi \times n \times 25}{13833{\cdot}6 \times 4} = \frac{n}{704{\cdot}54}$ sq. inches.* The same applies to the calculation of the electrical resistance corresponding to each number. The weight of No. 24 wire being 24×25 lb. per mile, and its resistance 10·5 ohms at the temperature of 80° Fah., the resistance of any wire will be $\frac{24}{n} \times 10{\cdot}5 = \frac{252}{n}$ ohms per mile. The strain the wire is capable of supporting, and that brought to bear upon a terminal insulator, or one placed in an angle, may be calculated in similar manner. It cannot be denied that this gauge is a rational one; but the pounds, the miles, and the Farenheit degrees render its general use impossible. Replacing these by kilograms, kilometres, and Centigrade degrees, the greatest obstacle to its generalisation would, no doubt, be avoided. But even in this case the question still remains—should we determine the size of a wire by its weight, and would it not be better to measure it by the diameter?

In favour of the former system, the fact may be advanced that it is by weight that wire is sold, bought and distributed along a line. If, for instance, we had to do with No. n wire, we know, without calculation, that a certain weight of the wire has a length of one kilometre. The strain the wire can bear without breaking is similarly proportionate to the weight and not to the diameter, and the same applies to the electrical resistance. In the case of stranded wire it is difficult to determine the resistance by the diameter; whilst if weight be taken it makes no difference whether the wire be stranded or solid. These are about all the advantages that can be insisted upon by the advocates of a gauge based upon the weight of wire.

On the other hand, this system necessitates a special gauge for each metal, since the specific gravity varies with the metal. In fact the B.W.G. originally applied exclusively to iron wire; and for this reason it was formerly termed "Birmingham iron wire gauge." At a later period, it was applied also to copper wire, but never to steel wire. Besides, the number of a wire is more difficult to determine by the weight than by the diameter; one must have an exactly-measured length of the wire and a balance, conditions which cannot always and everywhere be obtained; whereas an instrument for measuring the diameter may be carried in the pocket. Lastly, when exact indications are requisite, the diameter should always be given, as is shown by the example of M. Holtzapffel, and the general practice in England, where the diameter is always given in addition to the number in all questions of importance.

Although England is the birthplace of the irregular and empirical gauge named after Birmingham, several persons of that nationality, skilled in technical matters, have proposed that this gauge and the whole system pertaining to it should be relin-

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* For the benefit of learners, we may mention that π ($p\bar{i}$) is the ratio of the circumference to the diameter of a circle. It is expressed with sufficient accuracy for most purposes by the number 3·14159. The value $\frac{\pi}{4} = {\cdot}78539$ is the ratio of the superficial contents of a circle and a square of equal diameter. In the above equations, n stands for any given number.—[ED. *E.*]

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quished, and that the size of a wire should be indicated simply by its diameter in millimetres and fractions of the millimetre. Again, in America, a Committee was appointed in 1877 to examine the question of gauges; and this Committee, in its report read before the American Institution of Mining Engineers, also arrived at the conclusion that the size should be indicated simply by the diameter. The following were its recommendations:—

1. To abandon the system of fixed gauges.
2. To abandon the system of representing sizes by numbers.
3. The adoption of a system of expressing the sizes of wires by their diameters in thousandths of the inch, or (much more advantageously) by fractions of the millimetre.

The British Committee, mentioned at the commencement of the present article, arrived at somewhat different conclusions. Its object was to satisfy all opinions, to adhere as much as possible to the Birmingham gauge, to adopt a system of which the basis is virtually the weight of the wire, to determine the sizes of wires by their diameters, and to work in the direction of the metrical system. By means of these various concessions the Committee has aimed at rendering the new gauge, termed the "British Standard Gauge," or the "centimetre gauge" accessible to all nations, without disturbing too much the usages and traditions of those who have become accustomed to the use of the Birmingham gauge. To have produced a gauge fulfilling all these different *desiderata* in apparent opposition to each other is a success which reflects the greatest credit upon the committee, and especially upon Mr. Latimer Clark, from whom the suggestion emanated.

Between the numbers 5 and 36, the new gauge approximates very closely to the Birmingham gauge, as specified by Holtzapffel, and reproduced above. The wire No. 0 is exactly 10 millimeters in diameter. This wire serves as a basis for all the other sizes, whether larger or smaller; and the metrical system is thus safeguarded. But, whilst No. 0 is in agreement with the metrical system, the agreement here ceases, and the metrical system is not applied in the case of any of the other numbers of the gauge. We may, it is true, indicate the diameters of these other numbers in millimetres; but, since there is no simple ratio between the successive numbers, we have here no application of the metrical system. The British yards, feet, and inches, do not become metrical measures because their values are expressed in metres. But why was the metrical system applied only to the No. 0 wire which serves as a basis for all the other sizes? Because it was desired to satisfy also another principle, that of the determination by weight or mass. This new principle is adhered to as follows in the new gauge. The weight corresponding to each number is 20 per cent. lower than that of the preceding number. Thus No. 1 is 20 per cent. lighter than No. 0; No. 2 is 20 per cent. lighter than No. 1; and so on as far as may be requisite. The gauge has no limit in either direction. If we wish to pass from thin to thicker wires, each number is 25 per cent. heavier than the preceding number; for example No. 16 is 25 per cent. heavier than No. 17. This relation between the weights of the different numbers is naturally the same as that between their sectional areas. The ratio between the numbers 0 and 1 is therefore as follows:—

$$\text{No. } 0 : \text{No. } 1 = \frac{\pi d^2}{4} : \frac{\pi d_1^2}{4}.$$

Now, d being equal to 10 millimetres, we find $d_1 = 8{\cdot}94$ mm.; and, generally, to obtain the diameter of the number $n+1$, we must multiply the diameter of No. n by ·8944, or, in other words, the diameter diminishes, from one number to the following, by 10·557 per cent.

If we require to find the diameter of a wire No. $n-1$ from the diameter of No. n, we have

$$n : n-1 = \frac{\pi d^2_n}{4} : \frac{\pi d^2_{n-1}}{4};$$

whence we derive $d_{n-1} = 1{\cdot}118 \times d_n$. Thus, the wire No. 0 being 10 mm. in diam., No. 00 is $1{\cdot}118 \times 10 = 11{\cdot}18$ mm. In other words, the diameter of the wire augments by 11·803 per cent. from one number to another.*

We repeat that the gauge is not limited within these 53 numbers. We may, for instance, deduce the diameter of No. 0000 from that of No. 000, by multiplying the latter by 1·118.

$$12{\cdot}50 \times 1{\cdot}118 = 13{\cdot}97\text{mm.}$$

And to determine the diameter of No. 51 from that of No. 50, we multiply the latter by ·8944, obtaining the product ·034mm.

Whilst freely admitting that the new gauge is admirably devised, and that, if it be necessary to have any gauge at all, the present one has a claim to general adoption as being the best of existing gauges, we cannot discover why it should be necessary to use a gauge. Why should we complicate the idea of diameter with the supplementary indication afforded by a number? The English, we are told, have become accustomed to a system of numbers, only a few of which—for instance, the numbers 6, 8, 11, and 17—refer to wires which are most usually manufactured. Now the manufacturer and the purchaser are familiar with these numbers, and would only with difficulty take to a new system. For our part we think that the committee has allowed itself to be influenced in too great a degree by its scruples, and that, through being too conservative of old traditions with a view to satisfy everybody, it has been enabled only to arrive at an incomplete conception in lieu of a fundamental and rational reorganisation of the system.

A somewhat serious defect, for instance, of the new system is that the principle of the diminution of 20 per cent. in the weight fails to be applicable when the gauge is applied to strips or plates. The gauge, then, has no longer its *raison d'être*.

In order further to illustrate the shortcomings of this gauge, let us put ourselves in the place of a purchaser. For a certain purpose he wishes to give an order to a manufacturer for some platinum wire of 0·1mm. diameter. Doubtless no one would know by heart the diameters of all the numbers of the gauge. It is necessary therefore in the first place to have recourse to the table. But what aid does this afford him? No. 41 = ·103mm., No. 42 = ·092; nowhere does he find the exact diameter of ·1mm. Let us suppose that, by approximation, he can make shift with No. 41. How much simpler, in any case, would it be for him to simply specify to the manufacturer that he requires a wire ·1mm. in diameter! On another occasion he requires a wire of 3·5mm. exactly. But, again, this diameter is not found in the table; there is certainly No. 9, having 3·66, and No. 10, having 3·28mm. diam.; but there is no 3·50mm. Must he, then, be forced to run into fractions of the gauge numbers? No one will deny that it would be a new complication to be obliged to order No. $10\frac{1}{2}$ or $10\frac{1}{3}$, without even then having precisely the dimension he requires.

In conclusion, the new "British standard gauge" in spite of its indisputable merits, does not appear to us susceptible of being recommended for universal use, since it is surpassed in simplicity and accuracy by the method of simply indicating the size of wires by the diameter in millimetres and fractions of the millimetre. A gauge is not needed. The best one must always be a complication and a source of error, without any real advantage to counterbalance these objections. We think therefore that those countries which have adopted the metrical system will, without desiring to ignore the new British gauge, continue nevertheless to employ the millimetre and its fractions of tenths, hundredths and even thousandths if necessary to express the diameters of wires. This perhaps may be less scientific, but it is a clearer, a more precise and a shorter method.

The following is a table of the diameters of all the numbers of the new gauge between No. 000 and No. 50:—

Number of the Gauge.	Diameter in Millimetres.	Number of the Gauge.	Diameter in Millimetres.
000	12·50	25	0·615
00	11·18	26	0·550
0	10·00	27	·492
1	8·94	28	·440
2	8·00	29	·393
3	7·16	30	·352
4	6·40	31	·315
5	5·72	32	·281
6	5·12	33	·252
7	4·58	34	·225
8	4·10	35	·201
9	3·66	36	·180
10	3·28	37	·161
11	2·93	38	·144
12	2·62	39	·129
13	2·35	40	·115
14	2·10	41	·103
15	1·88	42	·092
16	1·68	43	·083
17	1·50	44	·074
18	1·34	45	·066
19	1·20	46	·059
20	1·07	47	·053
21	0·960	48	·047
22	0·859	49	·042
23	0·768	50	·038
24	0·687		

* The table of the new gauge, which is given at this point in the original, will be found at the end of the article

A SHOWER OF LIGHTNING.—*The Times* of the 24th inst. contains an interesting communication on this subject from its Geneva correspondent.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

We cannot undertake to return drawings or manuscripts, and must, therefore, request Correspondents to keep copies.

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A KNOWN DANGER ALLOWED TO EXIST.

We have on several occasions pointed out not only the inconveniences but the dangers of an extensive system of overhead wires in large towns. The advisers of the telegraph administration acknowledge the inconveniences and dangers, and for years past the department has been superseding overhead by underground wires. The introduction of telephonic exchanges, however, carried us back with a bound into those days when danger was unthought of. The first question of a telephone administration conducted under existing circumstances is to get money, and as a necessary result the only people considered are the shareholders and the subscribers. That the general public can advance good claims for consideration has probably never entered the heads of these companies, and never will till the public makes its power felt. We have ever been among those who do not hesitate to say that telephonic competition is impossible, and we might go further, and say that, if it was found desirable to place the administration of the telegraphs of the country in the hands of a Government department, it will be found still more desirable to place the telephonic system in the hands of the telegraph department. The system of underground wires adopted in the metropolis may be far from perfect, it may be more costly than overhead wires; but there can be no hesitation in concluding that it is less dangerous. The immediate cause of our writing on this subject is the fatal accident which occurred in Manchester last week. It seems that on Friday the cotton mills of Messrs. Pooley, Bradford-road, Manchester, were found to be on fire. The man in temporary charge of the fire escape had his charge taken away by the crowd, which, with the best intentions, was evidently unable to manage the apparatus. As the people dragged the fire escape along, the ladder caught the telegraph wires that were attached to a chimney, when, of necessity, in the haste and unavoidable loss of nerve on such occasions, something had to give way. It was the top of the chimney, which fell upon a woman, injuring her so that she died at the Royal Infirmary later on the same day. The evidence given at the inquest, held on Monday last, showed that the wire was a private one, and that there was no altitude defined by act of Parliament for such wires. Mr. John Doherty, the superintending engineer of the Post Office telegraphs, made some very judicious remarks on the question. He is reported to have said:—"I think the Corporation should have some control over these wires, and see that they are put up at a reasonable height. Mr. Superintendent Tozer had called attention to the altitude of the telegraph wires, which he considered too low, and in some cases they had been raised. His impression was that there were other wires as low as the wire in question in other parts of the city. It was probable after this accident that all the Post Office wires would be raised where it was deemed necessary to raise them." "Mr. Superintendent Tozer said the main ladder of the escape was 30 feet high. It could be lowered to a horizontal position and the ladder brought upon the ground. The ladder, when going to a fire, was run in a vertical position, and could only be so run if they were to go at any speed at all. When they had to go under telegraph wires they would naturally lower the escape. When passing through the streets the ladder would be inclined, and would then be about 25 feet high." The wires which were the cause of the accident were 22 feet from the ground, and the engineer under whose superintendence they had been erected stated that no reference was made to the Corporation as to the height at which they should erect wires, and he did not think would be made, unless the Corporation insisted on it. The minimum height of railway bridges, according to Act of Parliament, was only 16ft., and this wire was 22ft. high.

It will at once be admitted that there can be no comparison between a bridge 16 feet high and a wire 22 feet high, the former could not possibly escape notice, however high strung the nerves of a crowd might be, but the latter would easily pass notice till too late. Writing on the accident we have referred to, our contemporary the *Manchester Courier* remarks:—"A heavy responsibility will rest upon the Corporation if they neglect the recommendation contained in the verdict of the coroner's jury yesterday, with reference to the height of telegraph wires. . . In all probability, had the escape been in the care of a fireman, instead of having been taken possession of by an excited mob, it would have been steered clear of the wire, but the circumstance ought by no means to be ignored on that account. The fireman would have lowered the machine, at the expense of speed, because he could have seen the wire; but had it been night time, and dark, it may be that even he would have encountered the obstruction, and so damaged the escape as to render it unfit for the service for which it is intended. In such a case consequences of the most distressing character might ensue. There is no reason why these wires—which are being stretched in every direction over the city until in some places it assumes almost the appearance of an exaggerated pigeon cote—should be placed at an altitude less than that of the top of the highest fire escape; and now that the coroner's jury have recommended a change, it is to be hoped the Town Council will adopt such regulations as will prevent a repetition of the mishaps of Friday last." It is, however, not on this special case, but on general grounds that we object to overhead wires as at present fixed. A well-known contributor informs us that at

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a fire which recently occurred at Dalston there was imminent danger of a sad catastrophe. A number of wires were fastened to a chimney stack, and the fire raged all round. The crowd, of course, was in the most dangerous spot had the chimney stack with the wires fallen. The danger was pointed out to a policeman, who was powerless to act. The crowd saw no danger. Fortunately the efforts of the firemen subdued the fire, so that this particular danger was averted.

Considering, then, that in the case of fire such wires are dangerous, in the case of high winds, of heavy snowstorms, and other atmospheric conditions, the failure of wires is imminent, is it not time that some powerful jurisdiction should step in, and make the adoption of some other and safer system compulsory? It is frequently the case that the wires are fastened to structures not calculated to bear the constant strains they have to undergo, and, sooner or later, the damage done to, and, perhaps, by such structures, will be considerable. The agreement of the rival telephone companies will allow a better system to be more easily and readily adopted. The price obtained for the use of telephonic accommodation is such that, if the exchange system is generally adopted, the cost of perfecting the safety of the connecting wires will bear a very small proportion to the income of the companies.

CORRESPONDENCE.

SHORTHAND APPLIED TO THE PANTELEGRAPH.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The Pantelegraph was invented by the Abbé Caselli in 1856, but was not made of practical use until 1865, when it was introduced into France and Russia. The Pantelegraph is so little known that it will be necessary to give a brief description of it. It consists of three parts—the writing apparatus, the mechanism for regulating the synchronism, and the system of auxiliary batteries for charging and discharging the line.

Two curved tables are fixed on each side of the stand of the instrument, two of which are for the purpose of receiving a message, and the others for that of transmitting one.

The message to be sent is written with a non-conducting varnish on a sheet of silvered paper or tinfoil. When the varnish is dry, the sheet of tinfoil is placed on the curved table employed for the purpose of sending the messages.

A large pendulum, the bob of which is loaded so as to weigh about 16 pounds, is suspended from the top of the frame of the instrument.

The pendulums at each station are similar in length and weight, and their movements are controlled by electro-magnets, which ensure an absolutely uniform speed. The magnetism of these electro-magnets is reversed by the action of a local battery, the currents from which are circuited through them alternately by the action of the pendulum.

A pen is fixed by means of a rod to the pendulum, and is mounted so as to travel in an arc; and as soon as this pen meets with a line written in varnish, the current is momentarily interrupted, and a corresponding blank is left on the paper at the other end.

The tablets are connected to the negative pole of a main battery and with the earth, the other pole being connected to the line.

The current which actuates the electro-magnets is derived from a local battery, from the positive pole of which the current proceeds to a commutator controlled by a clockwork and a smaller pendulum. An alarum is placed above the instrument. This explanation will give an idea of the construction of this instrument.

The apparatus employed in France required one minute 48 seconds to go over a despatch of the smallest size (27 millimetres wide). On such a paper a message of 25 or 30 words may be written in the ordinary handwriting, and perfectly reproduced at a distance of 300 miles. Hence, 45½ despatches of 20 words each may be sent per hour. Although the speed attained by this instrument when employing the ordinary written characters is not so great as that attained by automatic means, there is no doubt that if shorthand were employed the speed attained would be much greater.

In order to prove this, it will be requisite first to consider the speed at which a long message may be sent by automatic means. In order to get the message punched out as quickly as possible, a large number of operators must be employed for that purpose, but under any circumstances the operation of punching must involve a considerable time, dependent upon the skill and number of the operators.

When once punched, as is well known, there is scarcely any limit at which the message may be sent by automatic means, but if a great speed is required several clerks must be employed to read the message as it arrives.

Although it may thus be shown that the message can be sent at a high speed, the employment of so many manipulators renders the attaining of such a speed impracticable for general purposes. The working speed by automatic means, with one operator at each end, is about 30 words per minute, not including the time which the message would take in being punched.

With the use of shorthand and the Pantelegraph, a much higher speed could be obtained. A report could be neatly and plainly made on tinfoil by the reporter at the rate say of 120 words per minute; this might then receive any requisite corrections, and be placed on the tablet of the transmitting apparatus ready for sending to the distant station.

As it was received at the receiving station it could be transcribed into the ordinary writing, or, as it is called, longhand, if necessary, but it may be suggested that with long messages, it would be more advantageous to have the message put into type directly from the shorthand copy, and in order to do this, it might be necessary for someone understanding shorthand to read it for the printers, but the rapid progress shorthand is making will soon render this an unnecessary operation. Of course a private message would have to be transcribed into longhand, but even when taking the time thus occupied into account, there is no doubt the message would be received much more quickly than if it had been sent in longhand, or by automatic means. The speed attainable when employing longhand with the Pantelegraph has been found to be in practice about fifteen words per minute, and as on the average we could get five words clearly written in shorthand into the space previously occupied by one word in the ordinary writing, we could obtain five times the original speed, namely 75 words per minute. Now, the question is, at what speed could the message be transcribed at the receiving end? As the eye in reading one word in shorthand would approximately only have to travel over a space occupied by one letter in the telegraph code, the speed attained would entirely be dependent upon the manipulator's speed in writing.

Even the trifling loss of speed by his transcribing the message himself might be obviated by his dictating the message to another clerk. In the course of time, as the value of shorthand as a means of writing becomes more appreciated, this transcription, with the large loss of time it involves, might be altogether obviated.

Of course this application of shorthand would be of the greatest use in sending long messages or reports for the press. One of the chief merits of this system would be the evident decrease of expenditure resulting from the employment of fewer manipulators than with the automatic system; as not only would the punching in the first instance be entirely obviated, but a message received at a station could be immediately forwarded to another station, so that many stations might receive a report in the same hour.

It has been suggested that the Morse characters might be transmitted by the Pantelegraph, and it is easy to see how this could be accomplished, but this would necessarily be inferior to the automatic telegraph system as used at the present time. It is doubtful as to whether there are any of Caselli's Pantelegraphs in existence at the present time, but if there are any of them remaining the employment of shorthand might receive a fair trial.—Yours, &c.,

MARMADUKE CLARK.

TELEPHONES.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Will you permit me to add another to the list of articulating telephones, or microphone receivers, published in your last issue? It is made as follows:—Take a round piece of mahogany, or other dry wood, two (2) inches in diameter and half an inch thick; in the centre make a circular hole, the size of a sixpence, to take the electro-magnet; on one face mark a circle the size of a bronze penny; just outside this circle, and touching it, make three holes equidistant from one another, and the size of No. 9 B.W.G. iron wire; in each hole put a piece of this iron wire long enough to project a little from the wood on each side; the

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electro-magnet is made of a piece of the same No. 9 iron wire, slightly less than $\frac{5}{8}$ of an inch long, and the reel is the size of a sixpence, and half an inch long, and is wound with No. 36 silk covered copper wire; the electro-magnet is placed in the hole in the wood, and the whole boiled in paraffin. Two pieces of thin wood, about $\frac{3}{16}$in. thick, and two inches in diameter, are also required; in one a recess is made the size of a penny and one-sixteenth of an inch deep, in the other a similar recess, but with a central aperture about half an inch in diameter to permit the sound to escape; two discs of thin iron 5 *mils.* thick, or ferrotype plate, are also required. Now take the disc of wood containing the electro-magnet, the wires of which have, of course, been led to convenient terminals, file down the ends of the three iron wires on one side of the disc until one of the thin iron plates when laid upon these three wires will *almost* touch the core of the magnet; let this plate remain on these three wires, put on the recessed disc of wood, which has no central aperture, and secure it by three screws. The settling of the other thin iron plate requires more care, but is done in the same way, the projecting ends of the three wires being filed down until the other iron plate, when placed upon them and the whole put in circuit with an articulating microphone, speaks distinctly. The recessed piece of wood with the central aperture is then placed upon the iron plate and secured by three screws, which must not be tightened too much, or the plate will not speak nicely.

We have now an electro-magnet between two thin iron plates, which plates are in metallic connection with one another by the three iron wires; one plate being adjusted at the best speaking distance from the core of the magnet, and the other plate as near to the core of the magnet as it can go without touching it at any time; the action of this latter plate is, I think, to absorb by induction the magnetism of the iron core of the magnet.

I have tried a great many forms of telephone, or microphone receivers, but have not found any superior to this; it can be used with any articulating microphone, and, by varying the details of construction, it can be made to speak distinctly, and at the same time be unaffected by the slight induced currents to which the more sensitive Bell telephone readily responds. These receivers work admirably with my cup-and-ball articulating microphone, and are so simple, cheap, and effective, that they would, if known, come into general use.

I have only to add that they are not patented, and that I have not any pecuniary interest in the sale of them.—Yours, &c.,

H. B. T. Strangways.

5, Pump-court, Temple, E.C., June 21st, 1880.

TESTING.

TO THE EDITOR OF THE ELECTRICIAN.

Sir: In your leading article of the 17th ult. which professes to be a history of testing, you make no mention whatever of my paper on this subject, which was read and discussed at the Telegraph Engineers' Society on 11th November, 1874, and which Latimer Clark described (in the discussion) as a more scientific method of testing than Mr. Laws's or Mr. Lumsden's.—Yours, &c.,

J. J. Fahie.

Teheran, Persia, May 18th, 1880.

JAMIN'S AUTOMATIC ELECTRIC LAMP.

It will be in the recollection of our readers that during the spring of last year the well-known *savant* M. Jamin exhibited to the French Academy a new electric burner, which he proposed to utilise not only for producing an electric light but also for blowpipe analysis. Since that time he has constructed an automatic lamp for adapting the new candle to ordinary use, and it has acquitted itself with success at a recent public trial at the laboratory of the Compagnie Générale d'Eclairage Electrique. A large company has been formed for introducing the light generally.

The peculiar feature of Jamin's candle, which distinguishes it from all other carbon candles of the same kind, such as those of Wilde and Rapieff, consists in the means whereby the arc between the ends of the two parallel carbon pencils is deflected or drawn out to a flame-like form. The deflection is produced by simply winding the wire conveying the current into an oval loop or hank surrounding the carbons, and the electro-dynamic attraction of the current in the wire on the current in the arc.

In the actual lamp this directing circuit makes 15 or 20 turns round the candles. It is made thin, in order not to obstruct the light, and encased in copper. It is of a rectangular shape, and round the upper end is clasped a soft iron ring, which acts as a magnetic pole, and attracts a hinged armature. In the middle of this frame are placed the candles, or pairs of carbons, between the opposed points of which the arc is to be established. There are usually three of them, but a greater number can be employed if the use of the light is to be prolonged. Each carbon hangs point downwards from a copper socket tube, into which it is set. There is no insulating matter between the carbons, as in the Jablochkoff candle, except air. The right carbon of each pair hangs vertically in a fixed socket, the left candle in a movable or hinged socket, and it is arranged that the weight of the armature acts by a leverage on these hinges so as to throw the carbons of each pair together.

The current on traversing the directing coil passes simultaneously down the three movable carbons, and can return by either of the three fixed carbons. In passing it lights those pairs which touch at the points. The passage of the current in this way magnetises the soft iron clasp or ring surrounding the upper end of the coil, and attracts the armature upward, so as to throw the hinged carbons apart from the fixed ones, thereby establishing the full extent of the arc in the first pair of carbons.

The arc continues whilst there is carbon to be consumed. When the current ceases the armature falls down again, the contact is re-established, and light again kindled. Thus the lamp is automatic.

When the first candle is consumed, the current is diverted to the next succeeding it. To effect this the fixed carbon holder can be displaced in a plane perpendicular to the plane of the coil. This displacement is brought about by a spring pressing on the holder near its root, but whilst the carbon is burning the force of the spring is opposed by a wire catch or detent which holds the carbon in its place. As soon as the latter burns down to this detent and fuses the wire the spring comes into play and urges the carbon outwards, thereby breaking up the arc and deflecting the current into the next pair of carbons or candle. The action is so prompt that hardly any change is perceptible, and the other lamps in the same circuit are not affected. Each candle lasts two hours, so that a new one only requires to be substituted at the end of this interval. Moreover, since the brass wire holding the carbon in its place is only fused at the end, it is sufficient to bend a fresh hook on the point, and it will answer the same purpose again and again.

One of the greatest inconveniences of electric lighting is the sudden and possible extinction of one of the lamps. Jamin's candles are not apt to incur this objection; nevertheless, to remedy the inconvenience, a device has been invented by M. Krouchkoll, one of M. Jamin's pupils. This provides for the opening at the moment of accident of a secondary circuit, which continues the current across the faulty candle, and replaces the extinguished lamp with a resistance equal to it, leaving the others in their original condition, and without any access of light.

It will be seen, then, that Jamin's lamp combines several good qualities. It allows of being lit or extinguished as often as may be desired, it only exacts one circuit for all the separate candles, it replaces automatically the burnt candle by a fresh one, it employs no insulating material but air, and therefore does not produce the blue or pinkish colouration noticeable in lights with solid insulators between the carbons. If, to begin with, the light exhibited variations of splendour, they were due to the imperfections in the carbons; but these have now disappeared, thanks to M. Carré, to whom so much is owing for his endeavours in this direction. It remains for us now to show the relations of effective illumination to the power consumed in producing it.

M. Jamin has obtained his economic results from the use of the Gramme machine, actuated by an Otto gas engine, which easily permits the amount of work expended to be measured, since it is rigorously proportional to the number of explosions taking place. The Gramme machine is composed of two distinct organs, the distributor and the excitor. The excitor supplies the continuous current which excites the electro-magnets, which induce a current in the bobbin of the distributor.

The current the distributor produces increases rapidly with its speed; but it is limited in intensity by the heating of the revolving ring. This heating has been reduced to one-fourth of its former amount by M. Jamin in following out theory in the construction of the machine. The expense, too, has been reduced to one-third of its old value. This reduction is expressed exactly by the figures:—

	Old Machine.	New Machine.
Expenditure of horse-power	1·394 h.-p.	0·51 h.-p.
Intensity of current	0·98	0·90
Speed	1,447 (turns)	1,433 (turns)

Various types of the Gramme lighting machine have been constructed. The largest and most costly habitually lights twenty-

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four candles, with carbons four millimetres thick; the smallest maintains four such candles. The last machines give only a comparatively feeble effect because they are badly employed. The small machine when going slowly takes up little power from the motor, but when the speed is raised to 2,500 turns a minute it absorbs about 10 h-p, and it is obvious that a corresponding increase of light should be obtainable from it. This is not the case in practice, because the heat developed in the machine is such as to melt the insulating material and burn the wires. In remedying this defect, by diminishing the resistance of the machine and increasing that of the circuit, M. Jamin has been enabled to maintain 24 lights by a machine of the so-called four-light class, and an engine of 24 horse-power.

The following results will illustrate this matter :—

Speed, 1,530 turns.

No. of Lamps.	Intensity. Of each Lamp.	Intensity. Total.	Expenditure in H.-P, of the Engine. Total.	Expenditure in H.-P, of the Engine. Per Candle.
1	134	134	2·81	2·81
2	113	226	3·58	1·79
3	107	321	4·07	1·38
4	105	420	4·43	1·11
5	95	475	4·70	1·94
6	96	576	4·91	0·82
7	93	651	5·04	0·72
8	92	736	5·11	0·64
9	86	764	5·09	0·57
10	74	740	5·07	0·51
11	70	771	5·04	0·46
12	62	740	5·01	0·42
13	56	718	4·80	0·37
14	50	700	4·60	0·32

It will be remarked that the amount of horse-power and the total light increase up to the 9th lamp and then diminish. It is clear, therefore, that if a great total of light is required it would be necessary to stop at that maximum number of lights. But, if a great number of feeble lights are required, it would be best to over-pass it. Thus it is that 24 candles of 4 millimetres diameter only demand one third of the horse-power.

The light of each Jamin lamp decreases with their number, a single one with a speed of revolution of 1,500 turns is equivalent to 134 Carcel burners; two lamps in circuit reduce each to 113, and, when there are 14, the individual value is not more than 50 Carcels.

This quantity of light is much more than that obtained by the ordinary electric candles, owing partly to the downward direction of the carbons. When placed upright the candle illumines the sky and wastes its light, when head downwards the light shines on the ground below. Again, the flame of the arc when downwards envelopes the points in an atmosphere at an enormous temperature, which increases their luminosity. A comparative trial of two similar candles in the same circuit has demonstrated that a candle with its points inverted yields five times the light of one with its points uppermost. Although the temperature of the arc is enormous the quantity of heat is not great, because the amount of matter is small. M. Jamin has compared this heat to that of a Carcel by putting successively the Carcel lamp and an electric candle in the same calorimeter. With equal lights, the combustion of the oil developed 45 times more heat than the electric arc.

As to the distance to which the light can be conducted, it is greater in proportion to the speed at which the machine turns. With 1,500 turns, one can introduce in the circuit the kilometre of copper wire of the millimetre diameter without sensibly diminishing the intensity. With 2,000 turns 4 kilometres of the same wire of 16 kilometres of two millimetres diameter can be inserted. It is thus possible for a large city to be lighted from the same central works.

Explanation of the Diagrams.

The foregoing description of the Jamin lamp will enable the reader to understand the diagrams without lengthy reference. As will be seen :

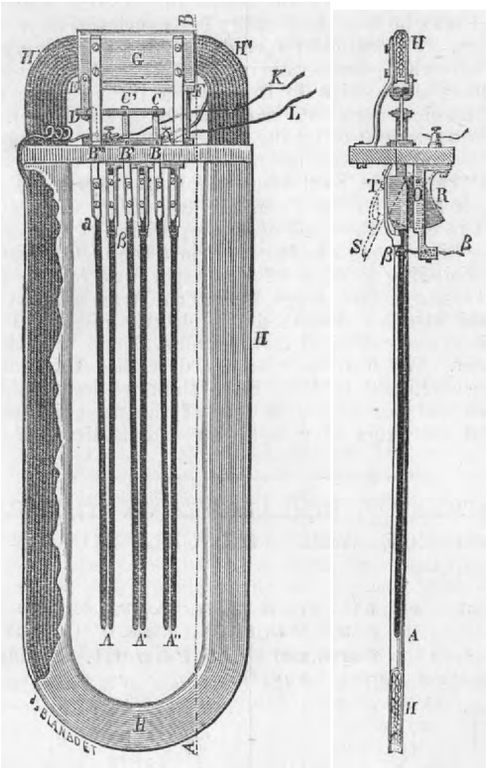
H, H′ shows the hank of wires surrounding the carbons.

A, A′, A″ shows the three candles surrounded by the wires.

The sectional diagram shows the carbon holder, hinged socket, shunt action, &c.

G is the soft iron ring acting as a magnetic pole on the hinged armature E, F.

It may be stated that Mr. A. J. Besly, C.E., is the engineer and agent for this system, and that it is intended to fix the price of each candle, which, as we have previously said, lasts two hours, at one penny. It is difficult to see how much cheaper carbons can be produced.



THE SOCIETY OF TELEGRAPH ENGINEERS.

(CONCLUDED FROM PAGE 47.)

We have already referred to Dr. Siemens' remarks on the use of electricity in metallurgical processes. A new branch of work was next discussed, relating to the use of electricity in horticulture.

In this portion of the paper, the author explained the experiments by means of which he has come to the conclusion that electric light produces the colouring matter, chlorophyll, in the leaves of plants, that it aids their growth, counteracts the effects of night frosts, and promotes the setting and ripening of fruit in the open air. It appears, further, that, at all events for certain short periods, plants do not require a period of rest during the twenty-four hours, but make increased and vigorous progress if subjected during daytime to sunlight and to electric light at night. These observations on combined sun and electric light agree with those made by Dr. Schübeler, of Christiana, who found as the result of continued experiment in the North of Europe during an Arctic summer that plants, when thus continuously growing, develop more brilliant flowers and larger and more aromatic fruit than when under the alternating influence of light and darkness. As Dr. Siemens has found that under the influence of electric light plants can sustain increased stove heat without collapsing, he is of opinion that forcing may be effected in an electric stove or enclosure containing an electric light, and that horticulturists may thus grow fruit of excellent aroma and flowers of great brilliancy without immediate solar aid. To test what can be done practically, the author has put down a steam-engine and boiler at his country residence near Tunbridge Wells, and intends to test the principles involved upon a working scale during the winter. The steam-engine which drives the dynamo-electric machine during the night for the purpose of giving light is to be employed during the day in transmitting power through an electric conductor to the farm for the purpose of carrying on small farming operations, such as turnip, chaff, and wood cutting, &c. Another interesting question which Dr. Siemens has set himself to answer is to determine which portion of the rays constituting white light is efficacious in producing chlorophyll, starch, and woody fibre, and which in effecting the ripening of fruit. For this purpose arrangements are in preparation to distribute the spectrum of a powerful electric light in a darkened chamber over a series of similar plants exposed *seriatim* to the actinic, light-giving, and thermal portions of the spectrum. Some experiments have been made with solar light in this direction, but no very conclusive results could be obtained, because the short periods of time during which the solar spectrum can be

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maintained steadily in the same place are so short that the effects produced upon vegetation have not been of a sufficiently decided character; whereas, with the aid of the electric light, the same spectrum may be kept on steadily for a series of days without intermission. The author referred shortly to the lamp which he designed for this purpose, having a focus unchangeable in space, and without obstruction to the rays of light falling downward. There is no clockwork; the carbons are pressed forward either by their own weight or by the force of springs, the motion being checked by an abutment against which the carbon presses at the junction of its cylindrical with its conical portion. This is at a distance of 1·3in. to ½in. from the arc centre, when the heat is sufficient to cause the gradual decomposition of the carbon, without being high enough to fuse or injure the metal abutment.

The concluding portion of the paper referred to the use of electricity as a motive power, and to the transmission of power. In this Dr. Siemens described the electric railway designed by his brother, and exhibited last year at Berlin and this year at Düsseldorf. We have so recently described this railway, and the paper contained nothing more than we have said, that we shall here end our notice of one of the most interesting and successful meetings ever held by the Society of Telegraph Engineers.

EXPERIMENTAL RESEARCHES ON THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY.

BY WARREN DE LA RUE, M.A., D.C.L., F.R.S., AND HUGO W. MÜLLER, PH.D., F.R.S.*

SUPPLEMENT TO PART III.

The Electric Condition of the Terminals of a Vacuum-Tube after their connection with the Source of Electricity has been broken.

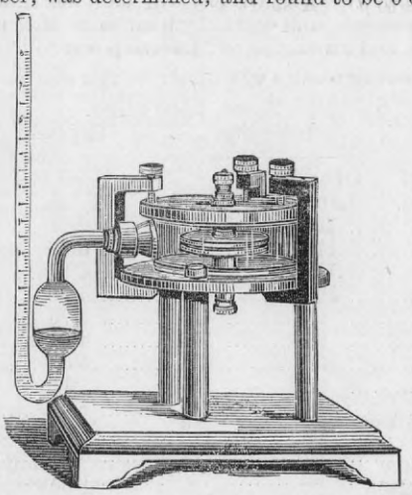
The question has been mooted whether there is a polarisation of the terminals of a vacuum-tube after the discharge through it has been interrupted by breaking connection between it and the source of electricity. This question we understand in the sense—does there exist a *chemical* polarisation as is the case, for instance, with the terminals of a voltameter under similar circumstances? It is evident that if a polarisation of this kind could be proved, the formula used for determining the tube potential ("Phil. Trans.," Part I., vol. clxxi., p. 65) would no longer hold good.

The problem is by no means easy of solution, and it has engaged our attention for the last five months. We believe, however, that the few experiments we are about to describe, and which we select from a long series, will show that there is really no such polarisation of the terminals.

We will first take the case of the voltameter; the arrangement of the apparatus employed in our experiments was shown by a diagram. A special key was used for breaking connection between any piece of apparatus and the battery, and connecting it afterwards instantaneously with a galvanometer. The terminals of the battery are attached respectively to screw-clamps carried by an ebonite bar supported on two ebonite columns. Touch-points in metallic contact pass through this bar, so that when brass springs are allowed to rise and press against these touch-points the battery is in metallic connection with the screw-clamps, and any piece of apparatus attached to them, as, for example, the voltameter. The voltameter employed has a resistance of 20 ohms; its electrodes are 2·5 inches long and 0·025 inch in diameter, and are separated 0·25 inch; it is charged with dilute pure sulphuric acid in the proportion of 1 volume of acid, sp. gr. 1·84, to 8 volumes of water. When the springs are suddenly pressed down by the fingers placed on the ebonite discs the connection is broken between the voltameter and the battery, and it is connected instantaneously with the galvanometer. The galvanometer actually employed was a Thomson galvanometer, whose constant, $C, = \frac{1 \text{ volt}}{1 \text{ megohm}} = 1{,}874$ scale divisions. On connecting a battery of 10 chloride of silver cells with the voltameter for a minute or less, and then suddenly pressing down the springs, there was a deflection to the left, say, of more than 1,000 scale divisions, although the $\frac{1}{999}$ shunt was used to reduce the current through the galvanometer; therefore, the deflection without the shunt would have been more than 1,000,000 divisions. By comparing this deflection with that produced by a half microfarad condenser, charged with 240 cells, it was ascertained that the deviation produced by the voltameter was equivalent to that of 111 microfarads.

A small condenser was substituted for the voltameter; it is made of a thin plate of glass 2 inches square and 0·0115 inch thick; the tinfoil coatings being 1·5 inch square, its capacity was found to be 0·00055 m.f. When charged with 3,600 cells, and afterwards connected with the Thomson galvanometer through the $\frac{1}{9}$ shunt, by pressing down the springs, the deflection was 136·5 divisions to the left; this multiplied by 9·92, the value of the shunt was equivalent to 1,354 divisions.

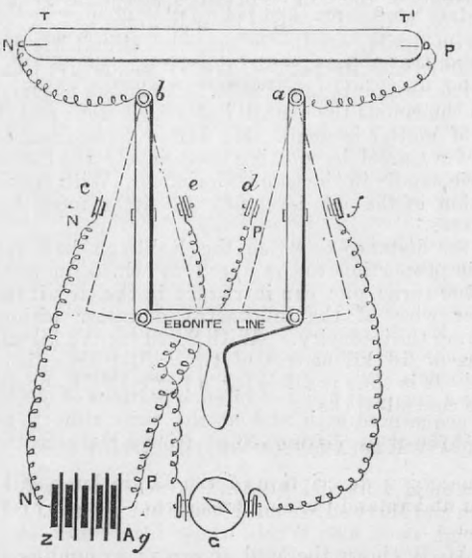
The apparatus, shown in Figure, which was constructed for another object already described * was connected with *a* and *b*; it consists essentially of two discs, 3·1 inches diameter, placed 0·13 inch apart. The capacity of this apparatus, when used as an air-condenser, was determined, and found to be 0·000058 m.f.



With 3,600 cells no discharge took place, and it merely charged up as a condenser. The deflection produced, when the keys *e* and *f* were pressed down, was (without shunt) 150 divisions, still to the left. It is evident, therefore, that the direction of the deviation throws no light on the question, for it is the same with the voltameter as with the condenser.

Tube 73, containing a residuum of acetylene, was now substituted for the air-condenser; it is 26·5 inches long and 1·5 inch diameter, the distance between the termals 23 inches; this tube was connected with 3,600 cells, current 0·00681 W. The tube potential was found to be 2,980 cells, and its resistance 449,500 ohms. On pressing down the springs *e* and *f*, so as to break connection with the battery and connect the tube with the galvanometer, there was a deflection of 11 divisions to the left, the same as before. The current was only $\frac{11}{1874 \times 1{,}000{,}000} = \frac{1}{170{,}000{,}000}$ W.

The diagram will illustrate the action of the special key, previously mentioned. When the handle is moved to the left, the



tube TT' is placed in metallic connection with the battery, whose terminals are shown attached to *c* and *d* (this is equivalent to the springs being allowed to press upwards against *c* and *d*); when the handle is moved to the right, then the discharge of the battery through TT' ceases, and the terminals of the tubes N and P are connected with the galvanometer, the extremities of whose coil are attached to *e* and *f* (this is equivalent to pressing down the springs).

* Abstract of a paper presented to the Royal Society.

* "Phil Trans., vol. clxxi, p. 76.

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On another occasion with the same tube, No. 73, with a discharge from 2,400 cells, the deviation to the left on passing down *e* and *f* was 20 divisions.

A tube with a hydrogen charge was now substituted; pressure 2 millims., 2,632 M, 5,100 cells, current 0·01639 W. This tube has already been described;* it is 37 inches (94 centims.) long, and $5\frac{13}{16}$ inches (14·8 centims.) in diameter. The distance between the terminals, a ring and a straight wire, is 33·5 inches (85 centims.). In the first place the battery was connected direct to the galvanometer, the positive to *e* and the negative to *f* (that is, in the same direction as if the positive were attached to *c* and the negative to *d*). A short piece of wire was inserted between *e* and *f* as a shunt, and the $\frac{1}{999}$ shunt was also used with the galvanometer, the direction of deviation was found to be to left, which it was desired to know.

On pressing down *e* and *f*, the deviation was to the left and only amounted to 2 divisions. On another occasion, at the same pressure, 3,900 cells, current 0·02925 W., the deviation to the left on pressing down *e* and *f* was from 3 to 5 divisions.

The same tube, with a charge of coal gas, pressure 3 millims., 3,947 M, current 0·01705 W., deflection, on pressing down *e* and *f*, 7 divisions to left.

The same tube, with air, pressure 1·5 millims., 1,974 M, current 0·02728 W., on pressing down *e* and *f*, deviation 20 divisions. The deviation was, therefore, greatest with air; but if due to a chemical polarisation, it would have been *a priori* expected to be greatest with coal gas, which is a mixture of decomposable molecules. The result of the experiments with tube 199 gave the following deviations:—

Hydrogen.	Coal gas.	Air.
3	7	20

Again, tube 199, 2,400 cells, pressure 1 millim., 1,316 M, current 0·02456 W., deflection on pressing down the keys, 16 to left; with 1,500 cells no discharge, yet a deflection of 10 divisions to the left was produced on pressing down the keys. The deflection in the latter case being clearly due to a static charge.

(TO BE CONTINUED.)

* "Phil. Trans.," vol. clxxi., p. 104.

LITERATURE.

A Physical Treatise on Electricity and Magnetism. Two vols. By J. E. H. GORDON, B.A. [Sampson Low, Marston, Searle, and Rivington, London.].

[PRELIMINARY NOTICE.]

We remember in our student days having for once in a way an hour's spare time, and having purchased several books at a bookstall, we were led to consider the method pursued by the ordinary writers on electricity and magnetism. In order to get as much information as possible in the time at our disposal, the book shelves were ransacked till a fairly good selection of books on the subject was at our elbow. The result is easily told. Each writer trod carefully in the footsteps of his predecessors, with almost no exception. Paragraph followed paragraph in the books in the same order and almost in the same words. Many of the illustrations were to be found in all the works, and these not illustrative of the description of general laws but of special experiments. It seemed, indeed, that a certain class of writers had not the power to write a book, but had time after time compiled volume after volume from half a dozen existing works.

Since then students have, indeed, been fortunate, and owing to the energetic action of authors and publishers, it can hardly now be said that our scientific books are not original. With such books as those of Sir W. Thomson, the late Professor Clerk Maxwell, Mr. Schwendler, Mr. Webb, and Mr. Kempe, we have the nucleus of a library of original work on electrical subjects.

Mr. Gordon, in the work before us, states his object to be, "to give a complete account of such portions of electrical science as I am acquainted with, and at the same time to regard them from a physical as distinguished from a mathematical point of view."

That a good work of this kind is necessary will be admitted. Thomson and Maxwell are mathematical; Kempe and Schwendler are special, as is also Webb, whose little work on "Electrical Accumulation" is not so well known as it ought to be.

Mr. Gordon goes on to say: "I have throughout endeavoured, as much as I am able, to connect the various phenomena described with the hypothesis adopted by Newton, Faraday, and Maxwell, namely, that there is no such thing as 'action at a distance,' but that all electrical actions are transmitted from place to place by strains of some continuous medium filling the space between."

Starting, then, upon our notice of this work with the ideas that a text-book from the physicist's point of view was required, that the matter should be correct, the method original and not compilatory, that modern work should be considered, that mathematical discussion should be eschewed as far as possible, and that illustration should be abundant, we shall proceed to consider how far the work before us fills the ideal we had conjectured.

In the first place, there can be no question as to the illustrations. The book is probably the best illustrated book of its kind, and what has been done has been well done. As regards mathematics, the author says, "for the understanding of the text of the work, no mathematical knowledge is required except that of algebra up to simple equations. There are, however, a few mathematical foot notes and appendices." Nor can we say that the author has followed in the footsteps of his predecessors, more truly it may be said that his plan is entirely his own.

The first volume of the work is divided into three parts, devoted respectively to electro-statics, magnetism, and electro-kinetics.

It is a little doubtful if the author has been able completely to sever himself from the mathematical school, and to consider the subject from the purely physical standpoint. We think it will probably be conceded that he has in various instances merely translated mathematical formulæ into words.

If for example we regard a hollow conductor from the physical point of view, we do not seek from it any confirmation if the law of inverse squares, because it is wresting a mathematical deduction from a phenomenon which has no bearing upon the subject. The reason why under ordinary circumstances the hollow conductor has no charge upon the inside, is simply that the inside *is not in the circuit*. It is quite easy to have a charge upon the interior and none on the exterior. The fact that induction as well as conduction involves a circuit is one of those physical phenomena the mathematical school has been slow to accept.

Charge, density, the effects of pointed conductors, &c., can we think be more easily and more satisfactorily explained from the purely physical standpoint than by any other method.

Mr. Gordon has done well in devoting considerable attention to the discussion of methods of measurement, and the following extract, vol. 1, pp. 52, 53, 54, will show his manner of treatment of the subject:—

FORCE.

"If a body, having mass, is moving with variable velocity, some force must be acting on it.*

The value of a force is the number of units of acceleration which it can produce on a unit of mass;† that is, it is equal to the number of units of velocity by which it can increase the velocity of a unit of mass in a unit of time.

The unit of force is that force which acting on a mass of one gramme for one second, can increase its velocity by a velocity of one centimetre per second.

This unit of force is called *a dyne*. Now the velocity of a body falling *in vacuo* at Greenwich increases at the rate of 981·17 centimetres per second for each second of fall—that is, at Greenwich the earth acts on a body at or above its surface with a force of 981·17 dynes per unit of mass, or to hold up a gramme at Greenwich requires a force of 981·17 dynes.‡

To sum up—

The dyne or unit of force is the force which, if it acted for one second on a mass of one gramme, would, if the mass was previously at rest, give it a velocity of one centimetre per second, or, if it was previously in motion, in the direction of the force, would in that time alter its velocity by that amount. And a dyne is $\frac{1}{981{\cdot}17}$ of the force of gravity on a gramme at Greenwich.

WORK.

The unit of *work* is *called* the *erg; it is the amount of work done by one dyne working through one centimetre*—that is to say, it is equal to the work required to move a body through one centimetre against a force of one dyne. To lift one gramme one centimetre at Greenwich requires an expenditure of 981·17 ergs of work, and if at the top of the centimetre we let the body go, it is able in falling one centimetre to do that amount of work.

C.G.S. APPLIED TO ELECTRO-STATICS.

We now come to the C.G.S. system of measuring electro-static effects.

QUANTITY.

The electro-static unit of quantity is that quantity of electricity

* *Newton*, Laws I. and II.

† It also equals the number of units of *momentum* which it can produce in a unit of time.

‡ Between the equator, where it is least, and the pole, where it is greatest, the earth's attraction varies by about 1-196th of its whole mean value.

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which at a unit distance will repel another equal quantity of the same kind of electricity with a unit of force—that is, in the C.G.S. system, it is the quantity of electricity which at a distance of one centimetre will repel another equal quantity with a force of one dyne.

Now, if the unit be determined experimentally (we will describe the methods used later on), we see how, for instance, any torsion balance might be graduated. Let the fixed ball be charged with two units, and let the movable ball be made to touch it; the balls will be then charged each with one unit of electricity, and will repel each other. Let the torsion circle be then turned, so as to bring them towards each other till they are at a distance of one centimetre.* The force between them is then one dyne, and it is exactly balanced by the torsion of the thread. The force exercised by the torsion of the thread at that particular position of the circle is then one dyne.

On repeating the experiment with charges of 3, 4, 5, &c., units we shall get the readings of the circle corresponding to forces of $1\frac{1}{2}$, 2, $2\frac{1}{2}$, &c., dynes. On constructing a table of these results, unknown quantities of electricity can be at once measured in C.G.S. units by the instrument.† This and similar processes are called determining the constants of the instrument.

Potential.

In the C.G.S. system the unit potential is the potential due to a unit of electricity at a distance of one centimetre. We have defined the *difference* of potential between two points, due to any given electrification, as the work required to be done to move a unit of electricity from one of these points to the other.

The unit difference of potential *is the difference of potential which there must be between two points for one erg of work to be required to move a unit of positive electricity from one to the other, the influencing electricity being supposed to retain its distribution unchanged.*"

Too great praise cannot well be given to the description, illustration, and modes of using modern instruments. Not only are the instruments described as a whole, but they are dissected, and the use and theory of every part explained.

(TO BE CONTINUED.)

WESTERN AND BRAZILIAN TELEGRAPH COMPANY (LIMITED).

A meeting of the shareholders of this Company was held on the 18th inst. at the Free Trade Hall, Manchester, "to receive a report from the directors." The meeting not being a statutory one, the directors decided that the proceedings should be private, and accordingly no reporters were present.

The report of the directors for the half year ending the 31st of March last, presented to the meeting, stated that after deducting £3,967 balance of "Special Cable Repairs," carried forward from last balance sheet, a profit of £15,992 had been earned upon the Company's system during this period. From the 25th December last the main portion of the Company's system had been in working order. The gross receipts from the 1st October showed an increase as compared with the corresponding period of the preceding half year of £20,521. At the last meeting in January, several important questions affecting the interests of the Company were pending, most of which had been been satisfactorily settled. The law suit with the Brazilian Submarine Company had resulted on the main point in a decision in favour of this Company, favourably affecting its annual returns. While regretting that this action should have been taken by a friendly undertaking, the directors were pleased to find their views confirmed by the highest legal tribunals. The question at issue between Mr. John Heugh, formerly chairman of the Company, had also been decided upon a basis which the directors believed would meet with the approval of the shareholders, although undoubtedly a compromise. The question of competition by the Brazilian Government land lines with the Company's system, had had the board's serious consideration, believing as they do that it was opposed to the letter and the spirit of the concession under which the cables were worked. Special representations had been made to the Government, and in view of the strength and justice of the case the board had strong hopes that the competition as at present carried on would not be allowed to continue, and the Government of Brazil fulfil in their integrity its pledges to the Company. The repairing steamer Norseman had been completely renewed with the exception of her hull, furnished with new engines, boilers, &c., and had left for her station in the Brazils fully equipped in every way for the purpose for which she was intended. This important work had been completed at a moderate cost, the directors having been able to make the necessary contract at a time when labour and materials were at a low figure. The International would now be recalled, and the heavy charge for the hire would shortly cease. There remained but a small portion of the cable requiring immediate renewal. For this purpose the Norseman carried an ample supply for present requirements, and upon her arrival on the ground it might be expected that repairs should be effected preventing the occurrence of any important break for some time. The prospects of the Company, both as to increased traffic and working of its cables, together with the settlement of the important suits referred to above, had improved since the directors last met the shareholders.

* *The diameters of the balls are supposed very small compared with one centimetre.*

† *This is only intended as an illustration. The experiment could not be carried out exactly as here described.*

THE TELEPHONE COMPANY (LIMITED).

An extraordinary general meeting of this Company was held on the 21st inst. at the Guildhall Tavern, Gresham-street, under the presidency of Mr. James Brand.

The Chairman stated that the meeting was only formal, and resolutions were proposed for winding up the Company voluntarily under the provisions of the Companies' Acts, and appointing Mr. Chas. Schiff as the liquidator to conduct the winding up of the Company. The following resolutions were also proposed:—"That, subject to the satisfaction of the debts of the Company, the shares in the United Telephone Company (Limited), to which this Company are entitled, be distributed by the liquidator as far as possible among the members, according to their interests in the Company." "That the powers of the directors be continued so far as may be necessary to carry out the agreement of the 13th of May, 1880, between this Company, the Edison Telephone Company, of London (Limited), and the United Telephone Company (Limited), or any necessary modifications thereof."

Mr. Galsworthy seconded the resolutions, and they were carried unanimously.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices June 23.		Business Done Week Ending June 23. Highest.		Lowest.	
Anglo-American Ordinary	61¼,	62	61¾		60½	
Do. "B"	91½,	92	91¾		90⅝	
Do. "A"	33½,	34	33¾		33	
Brazilian	8 7-16,	9-16	8 9-16		8 7-16	
Cuba	9½,	¾	9¾		9⅝	
Do. Ten per Cent. Pref.	15½,	16½	—		—	
Direct Spanish	1⅞,	2¼	—		—	
Do. Ten per Cent. Preference	10⅞,	11⅛	—		—	
Direct United States	11⅛,	⅝	11⅛		10⅞	
Eastern	8 15-16,	9 1-16	9 1-16		8⅞	
Do. Six per Cent. Debenture	103,	105	—		—	
Do. Five per Cent. do.	102,	104	—		—	
Do. Six p Ct. Preference	12⅛,	⅜	12¼		12¼	
Eastern Extension	9 1-16,	3-16	9 5-16		9 1-16	
Do. Six per Cent. Deb.	107,	110	—		—	
German Union	8½,	9	—		—	
Globe Telegraph & Trust	5 15-16,	6 1-16	6		5⅞	
Do. Six p Ct. Preference	11⅝,	12	12		11	
Great Northern	9¾,	10	10		9 15-16	
Indo-European	22½,	23½	23		23	
Mediterranean Extension	2⅞,	3¼	—		—	
Do. Eight per Cent. Preference	10½,	11	—		—	
Reuter's	9½,	10⅜	—		—	
Submarine	235,	245	241		241	
West India and Panama	1¼,	½	1 7-16		1⅜	
Do. Six per Cent. Preference	7,	¼	7⅜		7 3-16	
Western and Brazilian	6⅞,	7⅛	7⅛		7	
West. Union 7 p. Ct. 1st Mt.	120,	125	121		121	
Do. Six per Ct. Sterg.	104,	107	103		103	

TRAFFIC RECEIPTS FOR MAY, 1880.

Companies.	May, 1880.	May, 1879.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,900 estd.	3,108	—	208
Direct Spanish Telegraph Company	1,334 estd.	984	350	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,963	38,371	4,592	—
Eastern Extension Telegraph Company	26,570	25,845	725	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

ELECTRICAL AND SCIENTIFIC APPARATUS.—WHOLESALE MANUFACTURERS OF ELECTRIC BELLS, ELECTRIC REVERSING INDICATORS, and CONSTANT MANGANESE BATTERIES. Telephone Switches and Transmitters, Induction Coils and Vacuum Tubes, Terminals, Carbons, Wire, and all materials. Instruments made, repaired, or altered on the Premises. Illustrated Bell list free. Complete catalogue two stamps. Special quotations to the trade.—DALE and CRAMPTON, Manufacturing Electricians, 4, Little Britain, London, E.C.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby.

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SLIP

MELBOURNE.—The use of the telephone has been adopted in the *Argus* office, and gives great satisfaction.

THE JAMIN ELECTRIC LIGHT.—The name of the engineer, p. 69, in our last issue, should have been A. J. Berly, C.E., not Besly.

THE TEMPLE LIBRARY.—We understand that it is proposed to introduce the electric light, but as yet no system has been adopted.

THE ELECTRIC LIGHT.—The Siemens system of lighting has been adopted at the Holyhead Harbour, also at the Victoria Docks Extension.

EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY (LIMITED).—The interest due on the Five per Cent. Australian Government Subsidy Debentures will be paid, on and after the 1st July at the Consolidated Bank.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The company give notice that "during the temporary interruption of communication between Montevideo and Buenos Ayres by the cable of the River Plate Company, messages for the Argentine Republic, Chili, and Peru will be forwarded *viâ* Concordia, and such messages will be subject to an extra charge of 1s. 3d."

UNIVERSITY COLLEGE.—An effort is being made to secure the completion of the college buildings, and a meeting for this purpose was held at the Mansion House yesterday. The cost of the work of completing the buildings is estimated at £105,000, a part of which has been subscribed, and will be used for erecting a new section to the north wing, which it is hoped will be ready for students in October next.

IMITATION OF OLD SILVER.—The *Révue Industrielle* gives the following process for giving to any silver plated or silver article the characteristic appearance of antique plate. The article is dipped in a bath of water containing about 10 per cent. of sulphide of ammonium and then scratch-brushed with a brush made of glass threads or "bristles." When afterwards burnished with an agate tool, its surface becomes of a beautiful dark brown colour.

EARTH'S MAGNETIC FORCE.—The report of the Astronomer-Royal states that the time scales for the declination, horizontal and vertical force, and earth currents are complete to the end of 1879, and the base-line values for the declination and horizontal force are formed for 1879, but not yet laid down on the photographic sheets. The dip observations are reduced to the present time, and the deflection determinations of absolute horizontal force to the end of 1879. The following are the principal results for magnetic elements in the year 1879:—Approximate mean westerly declination, 18 deg. 40 min.; mean horizontal force, 3·911 (in English units), 1·803 (in metric units); mean dip, 67 deg. 36 min. 5 sec. (by 9in. needles), 67 deg. 36 min. 54 sec. (by 6in. needles), 67 deg. 37 min. 47 sec. (by 3in. needles).

GILDING SOLUTION.—The following solution, to be used at a temperature of from 120 to 180 Fahr., is recommended by M. E. Rod in *Le Monde de la Science*:—

	Parts by weight.
Crystallised Phosphate of Soda	60
Bisulphite of Soda	10
Cyanide of Potassium	1
Chloride of Gold	2·5
Distilled or rain water	1000·

To prepare this bath properly the water should be divided into three portions—viz., one of 700 parts and two of 150 parts by weight. The sodic phosphate is dissolved in the first portion, the chloride of gold in the second, and the bisulphite of soda and cyanide of potossium in the third. The two first portions are gradually mixed together, and the third is afterwards added. With this solution M. Rod uses a platinum anode (a wire or strip), adding fresh portions of the gold salt as the solution becomes exhausted.

CEYLON.—With regard to the faulty cable between Ceylon and India, the Superintendent of Telegraphs has sent an intimation to the Chairman of the Colombo Chamber of Commerce to the effect that the faulty section of the submarine cable between Ceylon and India has been cut out, and that telegraphic communication would be restored in a short time—probably the repairs have by this been effected. At that time a delay of several hours was caused between the island of Ramisseram on the Indian coast, and Tallamanaar, where the Ceylon end of the cable is landed. The authorities were showing great anxiety to put the local telegraphic service on a proper footing, and they had sanctioned the entire reconstruction of the lines between Colombo and Kandy, and Kandy and Matale. Double wires would also be established between Colombo and Matale, and an additional wire from Matale to Manaar. These improvements were doubtless being made in consequence of the approaching transfer of the island line of telegraph from the Indian Telegraph Department to one of local organisation and responsibility.

ELECTRIC CLOCKS.—A clockmaker of Copenhagen, named Louis Soenderberg, who for some time past has had charge of that city's electric timekeepers, has just invented an ingenius appliance which obviates the necessity of winding up the regulator from which the clocks in question "take their time." By a mechanical contrivance which periodically cuts off the stream of electric fluid emanating from the battery, and brings an electro-magnet to bear upon the relaxed mainspring in such sort as to renew its tension instantaneously perpetual motion is practically imparted to the works of the regulator—that is to say, as long as the batteries connected with it are kept properly supplied with acids. The discoverer of this important improvement has satisfied himself, by six months' successful experiments in his own workshops, that his system works faultlessly, and has applied for permission to adapt it to the electric clocks set up by the municipality in different parts of the Danish capital. Electricity, under Mr. Soenderberg's compulsion, is destined not only to make the Copenhagen clocks go, but to wind them up, with never-ending recurrence, until the "crack of doom."

THE ELECTRIC LIGHT.—A very successful application of the electric light has been exemplified in the lighting of the Orient steamship Chimborazo, which left Gravesend on the 24th for Australia. The installation consists of a Gramme machine generating the current by which seven incandescent lamps using 2mm. carbons are worked. Four of these are fixed in the main saloon, and the remainder in the steerage, where this mode of lighting is a great desideratum. The lamps are placed in series, but a resistance coil and automatic switch renders each independent from its neighbour. Several spare lamps are carried, which can be worked from the same machine. The whole current can also be switched on to a Crompton arc lamp, which is contained in a special lantern fitted with a reflector. This will be used when in port for loading and discharging cargo. The actual illuminating power of the large lamp is 4,000 candles, while each of the small incandescent lights is about 70. The whole of the arrangements have been carried out under the superintendence of Mr. Killingworth Hedges, C.E., the incandescent lamps and Gramme machine being supplied by the British Electric Light Company. The extension of the

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lighting to the other parts of the ship will be completed on her return.

A "SCARE" ON 'CHANGE.—Monday's *Liverpool Post* says: "For some little time past the department of the cotton market which deals with 'futures' has been officially closed from day to day by the ringing of an electric bell loud-toned enough to be heard even beyond the area of the Exchange, and the arrangement has been found to give every satisfaction. On Friday week it was proposed that the bell should be brought into requisition whenever any member of the association announced his inability to meet his payments at the clearing house. The proposal was adopted without a single opposing voice. On Saturday there occurred an incident, or accident, which effectually settled the new advertising medium. Just at the opening of the market, while operators were congratulating themselves upon the probability of an improved business, bang went the bell! Immediately there followed a rush from the flags to the clearing house, and a scramble from the newsroom to the flags. The signal was so totally unexpected that it created the most intense excitement, and produced a number of elongated faces and blanched countenances. The crowd at the door of the clearing house demanded in breathless impatience to know who had 'gone!' and a sigh of relief escaped when, after a little delay, it was announced that there was nothing wrong, and that the ringing of the bell was an accident."

A SHOWER OF LIGHTNING.—*The Times* Geneva Correspondent writes, under date June 20:—"A remarkable electrical phenomenon occurred at Clarens on the afternoon of Thursday last. Heavy masses of rain-cloud hid from view the mountains which separate Fribourg from Montreux, but their summits were from time to time lit up by vivid flashes of lightning, and a heavy thunderstorm seemed to be raging in the valleys of the Avants and the Alliaz. No rain was falling near the lake, and the storm still appeared far off, when a tremendous peal of thunder shook the houses of Clarens and Tavel to their foundations. At the same instant a magnificent cherry tree near the cemetery, measuring a mètre in circumference, was struck by lightning. Some people who were working in a vineyard hard by saw the electric fluid play about a little girl who had been gathering cherries, and was already 30 paces from the tree. She was literally folded in a sheet of fire. The vine dressers fled in terror from the spot. In the cemetery six persons, separated into three groups, none of them within 250 paces of the cherry tree, were enveloped in a luminous cloud. They felt as if they were being struck in the face with hailstones or fine gravel, and when they touched each other sparks of electricity passed from their finger-ends. At the same time a column of fire was seen to descend in the direction of Chatelard, and it is averred that the electric fluid could be distinctly heard as it ran from point to point of the iron railing of a vault in the cemetery. The strangest part of the story is that neither the little girl, the people in the cemetery, nor the vinedressers appear to have been hurt; the only inconvenience complained of being an unpleasant sensation in the joints, as if they had been violently twisted, a sensation which was felt with more or less acuteness for a few hours after. The explanation of this phenomenon is probably to be found in Professor Colladon's theory of the way in which lightning descends, as described in a letter on the effect of lightning on trees printed in *The Times* of May 18. The Professor contends that it falls in a shower, not in a perpendicular flash, and that it runs along branches of trees until it is all gathered in the trunk, which it bursts or tears open in its effort to reach the ground. In the instance in question the trunk of the cherry tree is as completely shivered as if it had been exploded by a charge of dynamite. A part of the shower which destroyed the tree fell where the little girl was standing, but, distributed over grass, left her unharmed, and was so disseminated in the cemetery that the six persons upon whom the electric rain descended escaped without serious injury. Another strange occurrence, but in no way connnected with atmospheric phenomena, happened a few days ago at St. Cierge, a village in the Jura. The principal room of an auberge there, known as the Cerf, was lighted by a hanging petroleum lamp, above which had been placed for the protection of the ceiling a metal plate. In time the woodwork above the plate became desiccated, and one evening last week it took fire, and when the innkeeper and his family retired to rest was all aglow—a fact, however, which they do not seem to have noticed. From the ceiling the fire was communicated to the room above, and was first discovered by a neighbour, who, early next morning, observing smoke issuing from the auberge door, gave an alarm, when, as none of the inmates could be roused, the door was broken open. The fire having gone on smouldering without bursting into flame had done little material damage, and was easily extinguished; but all the people in the house—the *aubergiste*, his wife, and sister—were dead. After the manner of country people, who have often a horror of fresh air, they had firmly closed their windows before going to bed, and the smoke, having no exit, had asphyxiated every one of them."

ELECTRIC ORE REDUCTION.—A process of electric reduction which, although it has not met the approval of many mining men and metallurgists, is said to give excellent results, is at present being introduced by Mr. Robertson, of Oakland, California. The process consists in heating the ore to a red heat, the ore being first broken to about the size of walnuts, then plunging the ore into a cold bath solution of salt, sulphate of copper, and cyanide of potassium in a given proportion. This bath disintegrates or rots the ore so that it is easily broken and ground to powder in the pans and amalgamated, saving, it is claimed, all the precious metals contained in the ore up to the fire assay, at a cost of about 3 dollars per ton. The process, as claimed, accomplishes the result obtained by milling, settling, and grinding with chemicals; the chemicals in the process being enabled to act immediately upon the disintegrated sulphides, instead of losing their power, as during the slow heating and grinding of the usual process. Another important point claimed is that the slimes, which carry off 20 to 25 per cent. of the precious metals in the usual process, and which in the Washoe process are run off and settled in vats to be worked separately at a loss of from 40 to 50 per cent., are by the Robertson process saved, as the clay is burnt in the heating of the ore, and does not interfere with the amalgamation, or hold the quicksilver in suspension, as it does when raw. The process has been favourably reported upon by Professor Henry A. Mott, who remarks that it is well known that the American mining districts abound in refractory or rebellious ores, such as the many classes of sulphides, tellurides, arsenides, &c., containing silver and gold, but owing to the nature of the impurities present the separation of the precious metals becomes a matter of great difficulty and expense; in fact, the proper treatment of such ores has been a problem occupying the attention of experts for years. He explains that the object of the gradual heat is to expel from the ore any sulphur it may contain, as sulphurous acid, and the heat is so graduated that the operation takes, for three tons of ore, about one hour to one hour and a half to bring it to a red heat, depending, of

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course, upon the amount of sulphur present. The expulsion of the sulphur prevents any "flouring" or "chloridising" of the mercury in the amalgamating process. The red-hot ore on falling into the cold bath, contracts, but immediately expands as the solution becomes heated and penetrates into the interior of the ore. The contraction and expansion together completely rot the ore, so that it may be easily disintegrated to a powder by rubbing in the hand. When ground to a powder, which requires thirty minutes, about 100lbs. of mercury to the ton of ore are added, and the whole is amalgamated wet for thirty minutes more, when it is ready to be strained and treated in the usual manner. The amount of mercury lost by other processes is from 1lb. to 3lbs. to every ton of ore, while the loss by this process is almost inappreciable. The use of salt, sulphate of copper, and cyanide of potassium is conceded by experts to be of great value in the treatment of refractory ores, the object of the two latter salts being to clean and brighten the precious metals and promote amalgamation; only one pound to the ton of ore is found necessary, however, so that the expense is but trifling. As the process does not depend for its success on any chemical reaction, but more upon molecular action, the same proportion suitable for one class of ores properly heated is suitable for others. This is a very important point, as it would be next to an impossibility, where the process depends strictly on a chemical reaction, to proportionate the chemical constituents so as to act uniformly with an ore whose mineral constituents fluctuate in combination and proportions. There are certain metals which will interfere with the result, such as lead; but ore containing less than 10 per cent. of galena can be successfully treated by this process.—*Mining Journal.*

Thunderstorms and Loss of Life.—A thunderstorm of exceptional severity broke over London at about half-past two o'clock on Saturday afternoon, and lasted for about half an hour. The lightning, both forked and sheet, was exceedingly vivid, the flashes following each other most rapidly, and the peals of thunder were very loud. The rain during the first part of the storm fell in torrents. During the afternoon a police sergeant and a constable of the X Division, named Rowan and Dent, who were on special duty in York-road, Wandsworth, were struck by lightning and rendered insensible. In the evening they were conveyed home in a cab to Paddington. A boy named Bone, living in Hope-street, Battersea, was also struck by the lightning, and received such injuries that it is thought he will not recover. A very heavy thunderstorm passed over South Durham, Cleveland, and the North Riding of Yorkshire on Saturday a little before noon. Mr. Henry Smith Stobart, of Witton Towers, a magistrate and leading colliery proprietor of the county of Durham, was struck dead by lightning while walking on the railway with Mr. T. Elliott, of Sunderland, about half a mile from his house. Mr. Stobart, who is well known in the coal and iron trades of the north of England, was about fifty years of age. The thunder and rain were very heavy in some parts of the district. A very severe thunderstorm, lasting upwards of three hours, visited the neighbourhood of Sherborne and Yeovil in the afternoon. In some places an immense quantity of rain fell, flooding many houses and battering down grass and other growing crops. At Trent two labourers named Brooks and Brown, who took shelter under a tree, were struck by lightning. Brooks was killed, and Brown was hurt so severely that he is not expected to recover. At Nottingham on Tuesday a man and a boy were killed by the lightning, and another man seriously injured. At Leicester, the same afternoon, the lightning caught one of the gables of St. Matthew's Church, tore off several yards of slates, and set fire to the roof. The flames were soon extinguished. Two houses were struck at Wolverhampton. One was occupied by Edward Luce, and here the force of the lightning was very great. The chimney and the roof fell in, and the furniture was smashed. If the accident had happened a few minutes earlier several of the family must have been killed, as they had just moved from sitting round the fire. A child, too, had just been taken from a bed in a room which was destroyed. At Abercarne the chimney of a house was struck, the electric fluid passing down the chimney on to a window sill, where some of the mortar and stones were dislodged. A little girl named Meredith, standing near the fire-place, was stunned by the shock. A woman was killed on Wednesday at Aley, county Kildare, by lightning. At Sutton a violent storm broke over the Birmingham volunteers' encampment shortly before six o'clock in the evening, just after a sham fight. Thursday's *Birmingham Gazette* says:—"While the sham fight lasted the storm had been gradually nearing. The lightning had been seen in the distance, and the rolling of thunder had been frequent. As though the disturbance of the atmosphere had hastened their arrival, the clouds quickly spread over the camp, and scarcely was the sham fight over before the whole sky was overcast, the rain descended in torrents, and the storm of thunder and lightning which followed was appalling. Few of the many thousands of visitors were able to leave the camp before it commenced, and they had to crowd together in the large marquees and in every available place of shelter. Soon after the commencement of the storm there were two flashes of vivid forked lightning in quick succession, accompanied by a heavy crash of thunder. The lightning struck the centre pole of the officers' mess tent, splintering it. Attached to this pole was the piping of Muller's 'Alpha' gas machine, which supplies gas to the camp, and along this in both directions the electric fluid ran. On one side it was by this means conducted into a tent which forms an ante room to the officers mess tent, in which the band was practising, and at the other end it was conducted to a group of ladies who were sheltering from the storm. The band had just finished playing a selection of music when the flash came, and the tent seemed to be filled with sulphur. The bandsmen had scarcely time to remark this before there was the second flash, and simultaneously men and stands were all thrown to the ground, and all felt the shock more or less. They felt it principally in their feet and arms. One was seriously injured. Mr. M'Hugh, who plays the big drum, was rendered insensible, being struck on the face, and it was some time before he recovered consciousness. The effect on the ladies was not quite so serious, though many of them were knocked down and sustained a more or less violent shock. Two gentlemen, one of whom was the son of Captain Cox, and one lady were seriously injured, the lady being struck on the neck. Captain Bache was also in the tent, and sustained a somewhat severe shock in in the left foot, but the inconvenience resulting from it was very temporary. One of the buglers belonging to the Staffordshire Volunteers was also injured."—A violent thunderstorm raged at Ilkeston between three and seven o'clock. At the Post-office the conductor belonging to the telegraph apparatus was struck by the lightning, and exploded with a report like that of a cannon. The apparatus was completely destroyed, and it is marvellous that the operators, who were near the instruments at the time, escaped with their lives. The conductor had only lately been put up to protect the apparatus, but so far from preserving it, it has been the means of destroying it. The lightning set fire to the roof of the Havelock Inn, and did a good deal of other damage.

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REPORT.

There is very little to add that is new in the cable world. Negotiations are being carried on for the construction of several lengths of cable, and very shortly we expect to hear that the vessels to be employed in laying the new Atlantic cable for the Anglo-American Company have sailed. We may state that this company's cables are working admirably, and that there has been no difficuly in forwarding the traffic brought by the sixpenny rate of tariff. This speaks well for the management, and its organisation. The Direct Company has also a good express traffic, which is carried on without a hitch.

A contemporary, the *Universal Engineer*, whose freaks in regard to electrical information we have previously noticed, again provides laughable fare for its readers, but evidently with no conception of its being anything other than serious. It describes a new method of manufacturing telegraph cables, devised by Messrs. Manly of Philadelphia:—"The process consists in arranging a metallic tube in a vertical position, and keeping an enclosed wire or wires under a tensile strain, at the same time introducing a molten insulating material into the lower end of the tube, and causing it to rise gradually and fill the latter, so as to surround the wire. The insulating material within the tube is then kept under pressure while cooling by means of columns of the same molten material bearing against the opposite ends of the tube. The apparatus employed for the manufacture consists of an elevated reservoir, with a supply-pipe leading downward from it, and a stationary lower head, connected with the pipe, and adapted to receive and retain the lower end of the tube in which the wire and the insulating material are placed. An upper head, which is movable vertically, is adapted to receive and retain the upper end of the tube, and is provided with a suitable mechanism for moving it upward. The wire or wires are introduced into the vertical tube, the wire being threaded through two perforated or templet plugs, and secured to a plug adapted to pass through the tube. The tube is filled from its lower end with the molten insulating material by means of a force-pump; and the tube and its contents are cooled gradually from the lower end upwards. After the section of cable thus formed has cooled, the tube with its enclosed wire or wires and insulating material is twisted by means of a special device connected with the apparatus." We should like to see an Atlantic cable thus made.

The *Journal Officiel de la République Française* of the 24th June contains an interesting report on French Telegraphs.

The *Scientific American* devotes one of its articles on American industries to the "manufacture of dynamo-electric machines and electric lamps," more especially describing that of Weston. Of this machine it says:—"The armature is built up of a series of thin perforated iron discs, which are firmly secured to the shaft by means of two nuts. Between the discs there are spaces of about one-eighth of an inch. At the end of the armature there is a tube surrounding the shaft, but larger in diameter than the shaft, and terminating at one end in a flange nearly equal in diameter to the armature discs. Each end of the armature consists of a large iron disc, having ribs on its periphery extending from one side of and parallel with the shaft. In the end of this thick disc a deep circular groove is cut, and a number of holes are bored through it parallel with the shaft. When the flanged tube is pushed over the shaft and fixed to the end of this thick disc the deep groove forms a chamber. In the periphery of the thin discs a number of grooves are cut, so that when the discs are placed side by side on the shaft these spaces are in line, thus forming grooves extending the whole length of the armature. The wire is wound in these grooves on both sides of the armature, and parallel with the shaft. The wire is wound in a manner somewhat similar to that adopted by Siemens, and the armature when covered with the wire is perfectly cylindrical."

Perhaps the most interesting information is that the works are run night and day, the electric light being used exclusively for lighting the factory. We know that the electric light is surely progressing in England, and it is well to have evidence of its extension elsewhere.

A PRELIMINARY ACCOUNT OF THE REDUCTION OF OBSERVATIONS ON STRAINED MATERIAL, LEYDEN JARS, AND VOLTAMETERS.*

BY JOHN PERRY AND W. E. AYRTON.

(CONTINUED FROM P. 41.)

In these experiments as the jar is insulated, u, $\frac{du}{dt}$, &c., equal 0, and the solution of the differential equation (1) is

$$v = A + B\epsilon^{-\beta t} + C\epsilon^{-\gamma t} + \ldots\ldots \quad (2),$$

where β, γ, &c., are such that $x+\beta$, $x+\gamma$, &c., are factors of the expression

$$x^n + a x^{n-1} + a x^{n-2} + \ldots + m x.$$

Hence, if we determine β, γ, &c., we determine the constants of the differential equation (1). Our method of reduction was as follows:—

If β is less than γ, γ than δ, and so on in equation (2), then, after certain intervals of time, certain of the exponents become unimportant; and if the time is sufficiently great, equation (2) reduces itself to

$$v = A + B\epsilon^{-\beta t} \quad \ldots\ldots \quad (3).$$

If a curve is obtained experimentally connecting v and t, it is easy to determine A, B, and β. Thus, from the observations given in the first two columns of the following table, corresponding with one of our several experiments with the Leyden jar (v being very slightly corrected by a curve), $\frac{dv}{dt}$ was determined for the various times.

Then, the values of v and $\frac{dv}{dt}$ for the same times being used as co-ordinates of points on a sheet of squared paper, we found that for the last 140 hours of our experiment the points lay, with very considerable accuracy, in a straight line; and hence, during this time, we may assume equation (3) to correctly represent the law of the soaking out of the residual charge. These plotted points enabled A to be determined. It is evident, also, that the values of $\log(v - A)$ and t, when plotted as co-ordinates of points, give a straight line, and enable B and β to be determined. We found that equation (3) for the particular experiment in question became

$$v' = 474 - 177{\cdot}34\,\epsilon^{-0{\cdot}0000637\,t} \quad \ldots\ldots \quad (4),$$

and giving values to t, we have calculated column 3 in the following table. Proceeding in precisely the same way with the remainders $(v - v')$ given in column 4, we obtain the other coefficients and exponents in the equation (2).

Soaking out of the Residual Charge in the Leyden Jar.

June 16, 1876.

Time in minutes.	Observed value of v.	v' calculated from (4).	Difference $(v - v')$.
0	0	296·7	296·7
0·5	82	296·7	214·7
1	102	296·8	194·8
2	120	296·9	176·9
4	138	297·1	159·1
7	155	297·4	142·4
10	168	297·8	129·8
20	190	298·8	108·8
40	213	301·1	88·1
80	236	305·4	69·4
150	264	312·8	48·8
250	296	322·8	26·8
350	324	332·1	8·1
500	345	345·0	0
700	362	360·1	−1·9
1,000	398·4	380·2	1·8
1,500	404·5	405·8	1·3
2,000	423·9	424·4	0·5
2,500	437·9	437·9	0
3,000	447·6	447·7	0·1
4,000	459·0	460·1	1·1
5,000	465·4	466·6	1·2
6,000	469·5	470·1	0·6
7,000	471·8	471·9	0·1
8,000	472·9	472·6	−0·3
9,000	473·6	473·7	0·1

We have stated above that we slightly corrected, by means of a curve, the values of v before putting them in column 2. It would make the present paper too long to describe in full the slightly wavy nature of the actual curves connecting v and t

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obtained in our experiments. That the variations are mainly due to slight fluctuations in the temperature of the room is seen from our finding a diurnal period in the waves. Indeed, we have found that small changes of temperature very materially affect all the phenomena with which we deal in this paper. But there is something more in these small waves than can be explained by changes of temperature, and possibly the solution (2) of the differential equation may have some coefficients which are sine and cosine functions of the time. A study of the constants on Professor Maxwell's theory ought to tell whether

$$x^n + a x^{n-1} + \ldots + m x = 0$$

has any unreal roots.

In the same way as that above described, we have obtained the exponentials of

$$u = A + B\epsilon^{-bt} + C\epsilon^{-ct} + \ldots \quad (5),$$

the solution of equation (1) when v is kept constant, from actual observations of the current flowing into a condenser from a battery with a constant electromotive force. The curve for u, just like the curve described above, possesses a slight waviness, and when this is neglected its simple logarithmic nature subsequently to a certain period of time is very striking.

In former papers read before this and other Societies we have given our reasons for believing that the phenomena of polarisation in voltameters, under the action of an electromotive force insufficient to produce disruptive discharge in the liquid—that is, rapid and visible decomposition—are of exactly the same nature as the phenomena exhibited by condensers having glass or other solid dielectrics. And we think that if our analogies fail for greater electromotive forces, it is because rupture of a solid dielectric introduces instantaneously entirely different conditions. An examination of the following reductions, which we give as a sample of the observations of current flowing into and out of a voltameter containing ordinary water and charged with one Minotto's cell (which has an electromotive force less than will produce visible decomposition), will show that there is a striking adherence to the logarithmic law, and that we here add another analogy to those we have already given between condensers with liquid and with solid dielectrics.

In the following table t is the time, in minutes, after applying one Minotto's cell; u is the current flowing through the voltameter, the unit of u being 0·371 microfarad per second; u' is the current calculated from the formula

$$u' = 180{\cdot}1 + 426{\cdot}6\,\epsilon^{-0{\cdot}01773\,t} \quad (6),$$

which we have obtained from the general solution (5) of the differential equation by a method explained towards the commencement of this paper.

Charging of a voltameter, consisting of Platinum Plates dipping in Ordinary Water, with one Minotto's Cell.

February 14, 1878.

Time in minutes.	Observed value of u.	u' calculated from (6),	Difference $(u - u')$.
4	690	587	103
10	618	537	81
20	526	479	47
30	455	431	14
40	398	390	8
50	355	356	−1
60	322	327	−5
70	297	303	−6
80	279	283	−4
90	265	267	−2
100	252	253	−1
110	240	241	−1
120	230	231	−1
130	223	223	0
140	216	216	0
150	211	210	1
160	205	205	0
170	201	201	0
180	198	198	0
190	195	195	0

After the deflection had diminished from 690 to 195 in rather more than three hours, the Minotto cell was suddenly removed, and the voltameter discharged through the galvanometer, the terminals of which at the same moment were reversed, so that the deflections for discharge should be on the same side as those for charging, in order to somewhat diminish the swinging of the needle.

The general differential equation (1), when applied to the discharge curve thus obtained by experiment, leads to the solution

$$u' = 11{\cdot}4 + 158{\cdot}5\,\epsilon^{-0{\cdot}0579\,t} \quad (7),$$

from which u', given in the third column of the following table, has been calculated.

Discharging of the Voltameter.

February 14, 1878.

Time in minutes.	Observed value of u.	u' calculated from (7).	Difference $(u - u')$.
6	244·0	123·4	120·6
10	156·8	100·2	56·6
15	91·4	77·9	13·5
20	62·0	61·2	0·8
30	37·8	39·3	−1·5
40	26·6	27·0	−0·4
50	20·6	20·2	0·4
60	16·4	16·3	0·1
70	14·0	14·1	−0·1
80	13·0	12·9	0·1

The reason why the exponentials in the equation connecting currents and time when charging differ from those connecting currents and time when discharging the voltameter, is as follows:—If r is the resistance of the battery, galvanometer, connections, &c., but excluding the resistance of the voltameter itself, then—

$$u = \frac{V - v}{r}$$

where V is the electromotive force of the battery, and v that of the voltameter, at any time (t) during the charging—

$$\therefore \frac{dv}{dt} = -r\frac{du}{dt},$$

$$\frac{d^2v}{dt^2} = -r\frac{d^2u}{dt^2},$$

which, when substituted in the general differential equation, enable the integration to be effected. But during the discharge after the removal of the battery, if r' is the resistance of the galvanometer, connections, &c., but excluding that of the voltameter itself, then—

$$-u = \frac{v}{r'},$$

$$\therefore \frac{dv}{dt} = -r'\frac{du}{dt}, \quad \&c.$$

Consequently, the constants in the differential equation, and therefore the exponentials in the equations of our curves, must be different.

Guided by this, we have arranged in our later experiments that r and r' should be both very small, so that the exponentials in the equations both of the charge and discharge curves should be the same.

(TO BE CONTINUED.)

OUR GAS CONTEMPORARIES ON THE ELECTRIC LIGHT.—The *Journal of Gas Lighting* says:—"Considerable importance was recently given by some English and French papers to the fact that the Paris *Salon* was to be lighted by electricity, and the asserted superiority of this light over gas for the illumination of paintings was accepted unquestioned by those who were too indifferent or too prejudiced to inquire very closely into the matter. We find, however, that a class of persons who must be admitted to have some slight knowledge of what is a good and what a bad light for a picture—the artists themselves—have protested against the use of the electric light at the *Salon*, this being stated to be the most unfavourable kind of illumination for effectively showing off their productions. The protest, however, comes rather too late. The agreement entered into with the Jablochkoff Company for the supply of the electric light has been carried out, and this system will, we suppose, remain in use until the end of the season, artistic protests notwithstanding. Again, when sober-minded, right-thinking people ventured to express a doubt as to the permanent adoption of the electric light by those shopkeepers in Paris who had been so ready to take it up as a novel and attractive, not to say startling kind of advertisement, their remarks were received by the worshippers of the rising luminary with all the impertinent contempt usually manifested towards opponents by converts to a new faith. Yet what do we find? The *Figaro*, whose office in the Rue Druot was one of the first buildings to be illuminated exteriorly by means of the electric light, has positively abandoned that system, and substituted for it two gas-lamps similar to those used by the Paris Gas Company in the Rue du Quatre Septembre, where, by the way, only half the original number of burners are now lighted, and yet the general illumination of the thoroughfare is, we learn, if anything, a trifle better than that of the neighbouring Avenue de l'Opéra, where the electric light still reigns supreme."

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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THE ELECTRIC LIGHT.

"The greatest source of light upon this earth is the Sun." That is the paradox with which Mr. Preece startled his immense and fashionable audience in the Albert Hall when he delivered his memorable lecture on the Electric Light. We have heard the sentence called a "bull," but we prefer to call it a paradox, not only out of respect to Mr. Preece, but because it is a real paradox. A little consideration indeed will show that all our sources of light upon this earth may be ultimately traced to the solar luminary.

If we strike a match, the energy of the stroke and of combustion is referable to the sun; if we burn a fire of wood or coal, the radiance given out is in some occult way dependent on the sunshine, which grew the primeval trees, of which the fuel is a relic; if we light a gas flame or an electric lamp, the same line of argument may be applied.

Not to descend too far into the inner heart of things, however, we may accept Mr. Preece's observation baldly, and agree with him that all the lights which man is capable of producing by artificial means are mere rushlights to the day. When Phœbus lends his light, all other earthly lamps must "pale their ineffectual fires." In other and more practical words, when summer comes even the electric light is not required for general illumination, except, perhaps, on a very limited scale. Hence, it is that the regular progress of the electric light during these months is a matter of agreeable surprise. And there could be no better answer to the gas companies who have affected to despise the electric light than this fact, that even during the summer it is steadily advancing in employment. Last winter was marked by a reaction against its introduction; but we have always maintained that its career is now established in prosperity, and from the signs which are to be seen in all directions, we anticipate that during the incoming winter manufacturers will be particularly busy in supplying electric lighting apparatus.

Recent decisions of the Committee of the House of Commons must have taught the organised opposition of gas companies to the electric light how futile their attempts to impede its public progress will prove. Their fruitless opposition to the Preston Improvements Bill, providing for the lighting of the streets of that town by electricity, and supplying motive power by the same agency, should be taken as a fair warning of what they may expect at other places. If, instead of a stubborn resistance to the inevitable, the gas companies would direct their efforts to a harmonious co-operation with electric lighting, they would only be wise in their generation. Engines are wanted to drive the dynamo-electric machines which generate the current for electric lamps; gas engines are in many ways preferable to steam engines for a great variety of places; let it be the duty of the gas companies, then, to foster the introduction of the best gas engines. For a long time these companies have enjoyed their fat dividends in unmolested ease; but that is a condition of existence which, in the nature of things, cannot go on for ever. By and bye the struggle comes; and the advent of the electric light is the antagonist which will rouse them from their prejudicial lethargy, and put them on their mettle. Little by little, slowly, perhaps, but surely, the electric light is extending its domain and encroaching on theirs. By and bye the infringement will be more seriously felt than it is now. And it should never be forgotten that the adaptation of the electric light to dwelling houses, though it is not an accomplished fact as yet, is far from being an improbability. The progress of invention is bringing us nearer and nearer to this consummation.

One of the most promising features in the future of the electric light is that questions are being asked about its introduction to light the House of Commons. Should such a course be deemed expedient we may be sure that it will be followed in many a large hall. It is perplexing, perhaps, to know why such questions should have been so long in asking. Canada has asked and settled, so in some cases has America, but we, as usual, follow.

There are now a considerable number of excellent electric lamps in the market, many of which are capable of yielding steady light suited to the halls and saloons of large mansions, theatres, &c., which have hitherto yielded a rich rental to the gas companies. The substitution in these of the electric light for gas is the first step of the invasion beyond the streets into the house; and there can be no reasonable doubt but it is only a question of time when smaller rooms and offices will be lighted by electricity.

Meanwhile, the electric light is gradually being disseminated as an illuminant of large areas, both on land and sea, and also underground.

The city of Wabash, Indiana, U.S., claims to be the first town wholly lit by electricity. Preston, in our own country, is seriously entertaining the proposal of Dr. Siemens to light its streets by means of Siemens lamps. Preston appears to be one of those typical examples which demonstrate the suitability of the electric light for the general illumination of country towns. Within a radius of 800 yards it comprises a market-place, corn exchange, town clock tower, and free library, all of which can be lighted by means of one steam-engine and a central station. Seventy-five small lamps would be required for these buildings and the streets, and twelve large lamps for the parks and open spaces. The engine would require to be of 82 actual and 30 nominal horse-power,

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and the probable consumption of coal is estimated at from two to two-and-a-half hundredweight per hour. It will take a sum of £9,000 to supply the machinery and plant in the first place, and the cost of maintaining the light will be about one-half of an equivalent gas illumination.

Besides its introduction into streets, the electric light is proving still more serviceable in railway stations, especially at Paris, Lyons, and Marseilles, where the Lontin light with the De Mersanne regulator is employed. This lamp burns all night without any attention, and is now a great improvement on the original Lontin lamp, as introduced at the *Gare du Nord*, Paris, in 1878. The gain to the Railway Company in expediting traffic, and preventing loss of goods, by neglect or fradulent means, is said to be very great. In the face of this experience it is somewhat surprising that our own railway authorities have not taken up the electric light with more enterprise. Tentative experiments have been made at one or two stations, such as London Bridge and Victoria, but with the exception of Aldersgate and Liverpool-street in London, and St. Enoch's new station in Glasgow, we are not aware that the method has been regularly adopted. Nevertheless, these pioneer lights serve to indicate a promising field for the more powerful lamps. At St. Enoch's station Mr. Crompton's excellent steady lamp has been installed by the British Electric Lighting Company, and the effect is very fine.

Printing establishments are also most appropriate places for the electric light, partly because the mechanical power required is already available, and partly because of the necessity of a bright light for printing operations. The absence of heating effect in the electric light is also an advantage over gas in a hot steaming press room. The introduction of Rapieff's lamp into *The Times* office was one of the first advances in this direction, and it has been followed in several Parisian and American examples. Rapieff's lamp is so meritorious that it is a matter of regret to see it so confined in its application in England. We trust that the inventor is not resting satisfied with his first success at Printing House-square.

A very useful and extensive sphere for electric lighting is opening up in the wharves and docks so numerous in our country. The great new Victoria wharves, to an extent of 10,000 feet, have, as is well known, been lit by 25 Siemens lamps slung on poles 75 feet high. The Siemens lamp acts very well in concert with others of its kind, for the blended effect disguises the occasional flickering of individual arcs. An interesting experiment was also made recently at the Portsmouth dry dock, where the Inflexible was propped up for repairs. This consisted in illuminating the whole ship and dock (a huge cavity 416 feet long by 110 feet wide and 39 feet deep) by means of 16 Brush lamps in one circuit, in order to determine whether, in case of war, it could be possible to continue the repairs of an ironclad by night as well as day. The monster turret ship was completely illuminated above and below, and the experiment was declared entirely successful.

Brush's lamp is well adapted for such a purpose, and it is, moreover, not a costly lamp. The expense of maintaining the light, as shown by these experiments, was only 2½d. per lamp for four hours. The machine employed made 120 revolutions per minute, and the engine was a 10 horse-power nominal. Our naval authorities have evidently found the Brush lamp satisfactory, since they have introduced it into the captain's cabin, ward room, and engine room of the Minoteur and Agincourt.

In America, we are told, this light is being rapidly adopted on board ship for the illumination of the saloons and decks. Besides the superior illumination of the electric light, its ornamental qualities are greatly in its favour for ocean and excursion steamers. A floating palace on the Hudson River, glowing with the radiant globes of the electric lamps, must be a striking sight in itself; and we should like to see our own Highland steamers the St. Columba and Iona fitted up with these lamps. Edison's lamp, if its durability could be depended on, would be eminently suited for ships, and we hope the trial of them which is now being made on board the ss. Columbia in America will prove their practical trustworthiness.

Mr. Edison has not succeeded in his enthusiastic aims, but, it must be admitted, he has performed a considerable amount of work in this direction.

The value of powerful electric head lights for ships is too obvious to call for comment here. Many lives have already been saved by them from the consequences of collision with icebergs in the Atlantic, and it may be safely predicted that many more will be saved. Nor need we dwell upon the application of the electric light to lighthouses. That is an old and recognised usage. Its application to buoys is, however, more novel, and it is reported that Mr. Edison has devised a small magneto-electric engine, worked by the rise and fall of the buoy on the waves, and capable of keeping up an Edison light of one gas-jet power. An English patent, by Mr. De Sussex has also been taken out for a vacuum light, maintained by the current from an induction coil fed by battery plates immersed in the salt water of the sea.

We come now to another area of usefulness for the electric light which is neither on land nor water, but may be under both — we mean in mines. Some difficulty has been found in making a moderately-powerful lamp fitted for the narrow galleries of a mine, and so enclosed that it would not set fire to the marsh gas or fire-damp which is the terror of the miner. Mr. André's incandescent carbon lamp, which burns in the carbonic acid of its own making, is so far as we are aware, the best of these extant in this country ; but we understand that a very convenient form of the Brush lamp has been successfully introduced into the Cleveland Iron Mines in America. The *Marquette Mining Journal* says the whole of the workings are brightly illuminated by lamps suspended by slack wires from the higher parts of the roof; and the result is that the operations by mining are carried on with much greater safety and cheerfulness than heretofore. And if with greater safety and cheerfulness, then also with greater expediency and thrift. Here, again, we are out distanced by the pushing Yankee. While we are trying new lamps here and there he is adopting them. We are apt enough to invent, but slow to appreciate.

M. FONVIELLE'S EXPERIMENT.

Some weeks ago, as our readers will remember, we alluded to a new contrivance which had been dignified by its inventor with the grandiose name of "Le Gyroscope Electro-magnetique," and we took occasion to point out that the late Sir Charles Wheatstone had used a similar device to regulate one of his electric clocks. Mr. Robert Sabine was kind enough to write and inform us the number of an English patent which contained a description of such a device, and on examining the patent we found the apparatus essentially described. It is a dangerous emprise, however, to rob a new-fledged *savant* of his one discovery, especially when that *savant* is an editor, and can discharge the columns of a whole journal against one. M. W. Fonvielle, the editor in question, has taken us to task for making this matter clear in a style which we cannot allow to pass unnoticed, although we would

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fain do so. In the number of our worthy contemporary *L'Electricité* for May 5th, 1880, M. Fonvielle does battle against the host of detractors who have arisen to shear him of the glory of his great discovery. In the estimation of M. Fonvielle this discovery is apparently one of the grandest which have distinguished modern times. But it would seem that a stubborn world will not view it in the same light, and there are actually some people base enough to insinuate that it is not even new.

M. Fonvielle's claims have tickled the Parisian love of banter, and given rise to some small jokes at his expense. But M. Fonvielle does not mind small jokes. "In spite," he says, "of certain comic allegations, the magneto-electric gyroscope continues to be the preoccupation of electricians, and even of those who affect to see nothing new in it. Though barely outlined, the theory of this instrument, so pregnant with futurity, and which has already won a niche beside the radiometer, has already suggested discussions of the highest interest." He then goes on to quote M. Jamin's remarks on the subject at a meeting of the French Academy on March 12, in which that famous electrician explained the rotation by the greater power of the direct induction currents generated in the Ruhmkorff coil (due to rupture of the primary circuit) over the inverse currents (due to closure of the primary circuit). This differential power turns the disc in one direction. But this simple explanation does not entirely satisfy M. Fonvielle. "We see," says M. Jamin, "that this experiment does not teach us anything new, and finds its explanation in well-known principles." "What!" exclaims M. Fonvielle, with just indignation, "an experiment teaches nothing new because it finds its explanation in known principles!!! Is it necessary for an experiment to teach something new that we should have recource to unknown principles? Is it necessary, to merit honour, to act like those foreigners who invoke the agency of a ridiculous molecular bombardment? What! the radiometer would have taught us nothing if we could have explained it by the ordinary principles of electricity! What a monstrous antiphilosphical absurdity is this to appear in the pages of the most serious and influential French scientific journal (the *Comptes Rendus*), which has been published for many years, and with which we ourselves (M. Fonvielle) had once the honour to collaborate!" Then after gloriously supporting his position against M. Jamin by the illustrious examples of Franklin and Faraday, M. Fonvielle thrusts his lance at us.

"Our *confrère The Electrician* of London publishes in the number for April 24 an article on the electro-magnetic gyroscope which he considers as being a very interesting instrument, but after that avowal, in which we agree with him, he adds: this experiment is not new, it was made ten years ago by M. Charles Wheatstone for the regulation of an electro-magnetic clock. General (*sic*) Sabine will be able, we think, to give us the details of the subject."

Now, it is a very singular thing, and one which must have struck all readers of French, that our ingenious neighbours never seem to be able to give a foreign name, or a quotation from a foreign language correctly. Why this is we cannot presume to explain. Perhaps it is because they do not think it worth while,—the rest of the world, with their barbarous names, are beneath their consideration. In the same number of *L'Electricité* we find Sir William Thomson spelt with a *p*, Mr. Trowbridge written Tonbridge, Helmholtz given as Helmnotz (an unpardonable ignorance), the Royal Society is stated to have been founded in the reign of Charles XI. (!), and, more unaccountable still, Mr. Sabine, the well-known electrician, is transformed by the playful *literateur* into *General* Sabine, although his proper name was down in plain printers' ink before him in the article quoted from. Has M. Fonvielle, then, only heard of one Sabine, or does he imagine that no less an authority than the renowned physicist can be intended. However it be, the General is soon disposed of by M. Fonvielle. "General Sabine, whose testimony is invoked, is more than eighty years of age. If, then, we may not suspect his loyalty, we have good grounds for doubting the accuracy of his memory." Thus does he crush the innocent general with his dotage, and demolishes the wrong man. Sir Charles Wheatstone suffers a more serious attack, which out of respect for his memory we will not repeat.

In a subsequent number of our contemporary *L'Electricité*, May 20) M. Fonvielle discusses Mr. Sabine's letter, and the extracts we gave from Mr. Stroh's patent. The usual French errors of translation are here apparent also. For example, he contrives to conclude from the letter that though Mr. Sabine implies that Sir Charles Wheatstone tried the experiment in question he did not succeed. Now, we understand Mr. Sabine's letter to mean not that the rotation was not obtained, but that the particular application of the device was given up. The same remark would apply to Mr. Hjorth's invention. As for Mr. Stroh's contrivance, M. Fonvielle repudiates it altogether, on the grounds that he caused a magnetic needle to rotate instead of a soft iron disc, and rotated it by alternate reverse currents instead of induction currents. The difference between these cases is one of detail. Mr. Stroh employed a magnetic needle, whereas M. Fonvielle employs the more elaborate contrivance of a soft iron ring made into a magnet by the induction of another permanent magnet fixed over it. Again, if the currents induced in the secondary circuit of an induction coil by the making and breaking of the primary circuit are not in the reverse direction to each other, what are they?

After bestowing a great deal of notice on his "electric wheel," as we prefer to call it (after the analogous lecture experiments of "Barlow's wheel" and disc), M. Fonvielle narrates its reception in this country, and incidentally reveals a very interesting historical fact. "The physicist," he says, "who best seized the importance of the new experiment was the *preparateur* of Mr. Spottiswoode, who on seeing the gyroscope act for the first time exclaimed, "A wonderful experiment, which will make people think!"—a great utterance, especially when translated into French; but we question very much if Mr. Spottiswoode's assistant meant anything very particular by this, except, perhaps, to pay M. Fonvielle an amiable compliment.

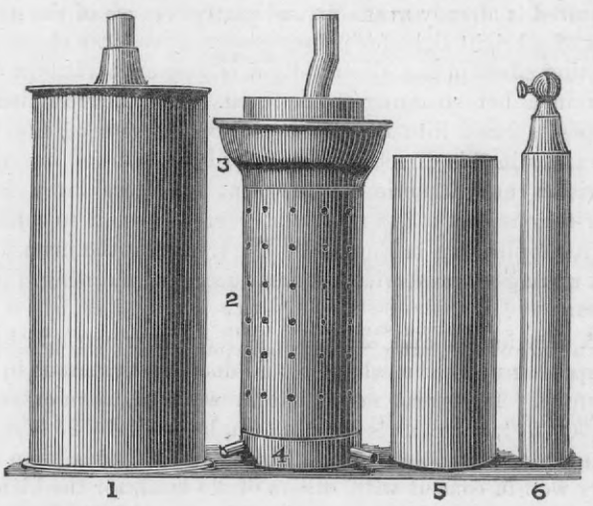
A MODIFIED DANIELL CELL.

Mr. S. J. Browning, of Portsmouth, sends us photographs of a cell he has constructed, of which he says:—

"While using the same materials, and the same strength of solutions as those of the ordinary Daniell, it gives twice the amount of current.

"It can be clearly perceived that my main object has been the reduction of the internal resistance, which I believe I have accomplished to the utmost without reducing its constancy."

The accompanying diagrams illustrate this cell.



(1). Outer copper cylinder.
(2). Inner copper cylinder, which encircles the porous cell within ⅛-inch of same.
(3). The copper shelf surrounding No. 3 for holding sulphate of copper.
(4). A wooden cylinder with step turned inside, to keep porous cell in centre of No. 2, and with three wooden plugs, to keep No. 2 in centre of No. 1.
(5). Ordinary 8in. porous cell.
(6.) Cylinder of zinc.

Mr. Browning uses small blocks of vulcanised india rubber to keep the zinc in the centre of the porous jar, and again to keep the porons jar in the centre of the cylinder. He also uses a disc of felt for the zinc to rest upon.

THE ELECTRIC LAMPS OF M. TCHIKOLEFF.

M. Tchikoleff, the head of the electric lighting department of the Russian artillery, has addressed to *La Lumière Electrique* a communication, of which the following is a translation, in which he claims that the application of derived currents which has been successfully adopted with the lamps of MM. Lontin and Siemens was employed by him as far back as the year 1871.

"Having experimented for a lengthened period with the Foucault and Serrin regulator lamps, which were considered to

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be the best at the period when I took up the question, I was able to observe in them the following defects:—

1. Several lamps, arranged in series or in multiple arc in a circuit, would not continue to work.

2. These lamps could be worked only by very powerful currents, whereas with a lamp regulated by hand the voltaic arc could be obtained with weaker currents, giving of course a less intense light.

3. They worked with regularity only when the current was constant, or varied within very restricted limits.

I traced the cause of these defects to the fact that the working of the regulating mechanism was based upon a kind of equilibrium between the attractive force of an electro-magnet and the counteracting force of a spring. Such a system does not regulate the distance between the charcoal points, but only the general force of the current in the circuit. Now under these circumstances it is possible that, when two or more lamps are placed in series in a circuit, one of them may have its carbons in contact, whilst the carbons of the other lamp or lamps are at a greater or less distance apart, without the equilibrium between the electro-magnets and the counteracting springs being disturbed.

Now it was to obviate this defect that I endeavoured to devise an arrangement which, whilst allowing each lamp placed in a circuit to be independent of the general intensity of the current and its variations, would enable it to maintain constant the resistance of its own voltaic arc, and this arrangement appeared to me obtainable by applying to the regulator lamps the principle of the *differential action of derived currents*.

In was in 1869 that I made the first experiment on the foregoing arrangement with a regulator lamp of M. Foucault, the counteracting spring of which I replaced by a supplementary electro-magnet traversed by a very weak derivation of the current, parallel to the voltaic arc. This electro-magnet was wound with a wire of high resistance, and the current producing the voltaic arc passed through the other electro-magnet. The armatures of these electro-magnets were placed at the two extremities of a rocking-lever, carrying at its centre of oscillation an arm which controlled the mechanism for increasing or diminishing the distance between the carbons; and the rocking-lever was in equilbrium when the voltaic arc possessed its normal resistance.

It is easy to understand that, with this arrangement, as the resistance of the arc becomes greater, the strength of the electro-magnet through which the current passes decreases, whilst the other electro-magnet becomes more powerful; so that the arm no longer remains in its vertical position, and by its inclination influences the mechanism which brings the carbons closer together. The contrary effect is of course produced when the inverse action occurs. An arrangement which, like the one in question, maintains constant the resistance of the arc evidently does not exert any effect upon the general intensity of the current in the circuit; for the variations of this intensity, outside of the lamp, exert always the same effect upon the two electro-magnets which control the latter.* The experiment with the Foucault lamp gave such good results that I decided to undertake the construction of a new lamp as free as possible from the defects inherent to the Foucault regulator, and to those based upon the same principle.

After some carefully made experiments with lamps having automatic regulation, and others regulated by hand, I ascertained that the latter would give a constant light with a much less number of battery cells than was requsite with the former. Thus with hand regulators I could obtain satisfactory results with 24 or even 20 Bunsen elements, whilst with the Foucault and Serrin regulators it was necessary to employ at least 40. The cause of this in the first place is that, in these regulating lamps the movements communicated to the carbons are always too sudden *(prompts)* for comparatively weak currents, and, in the second place, that these movements are constant instead of being proportionate to the intensity of the current passing by the voltaic arc. From this I naturally came to the conclusion that, in order to obtain a lamp suitable for practical working, it was necessary to apply the following three principles, which I consider as fundamental:—

1. To maintain constant the resistance of the voltaic arc we should not employ a constant mechanical force such as that of a spring, but a weak derivation from the main current, parallel to the voltaic arc.

2. To obtain by means of a special derivation from the main current the movements augmenting or diminishing the distance between the carbons, in order that the rapidity of these movements may be proportionate to the intensity of the current producing the voltaic arc.

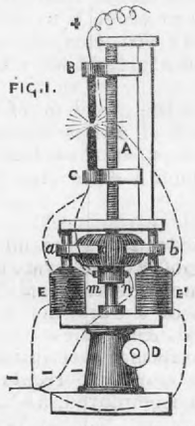
3. To make arrangements such that this rapidity of the movements communicated to the carbons should, at certain periods, be proportionate to the variations in their distance; that is to say to arrange the apparatus so that, in the case where the carbons have to be moved towards each other through an appreciable space, the movement communicated to them may be more rapid than when they have to be moved through a very short distance.

In 1871 I had constructed a lamp which fulfilled the two first of these principles, and which was brought before the Moscow Society of naturalists. In this system I employed as motor a small electro-magnetic machine of Froment, worked by a derivation from the principal current passing by the carbons; and above this electro-motor, the axis of which was vertical, were placed the two electro-magnets of the differential system above referred to. An armature common to both and suspended *between* their poles like a pendulum, reacted upon a double system of gearing, the axis of which, furnished with two angle-wheels of unequal diameter, would present to the electro-motor one or the other of these wheels according as one or the other of the two electro-magnets was the more energetic. As the wheels in question corresponded to two opposite points of the driving wheel, the movements produced were in opposite directions and could increase or diminish the distance between the carbons with a rapidity greater or less according to the intensity of the current, since the working of the *motor was dependent upon this* intensity. The drawing of this lamp has been in the polytechnic museum of Moscow since the commencement of the year 1873.

At the end of 1873, M. Jablochkoff, who at that period had a mechanical workshop at Moscow, being convinced of the superiority of the systems of constructing lamps on the derived current principle, made in his workshop a lamp on this principle. I shall not refer to the experiments with this lamp, which gave full satisfaction to several persons. For my own part, I was but partially satisfied, on account of its complication, and because it did not fulfil the third of the fundamental principles I had laid down.

In 1874, I arranged a new lamp, the design of which I brought before the physical section of the Moscow Society of Naturalists, and which is represented by Fig. 1.

FIG. 1.



E E′ are electro-magnets disposed like those on the other systems and having poles, *a b*, spread out in circular form as in the Gramme machine. K is a Gramme or Siemens ring, the rotary motion of which causes the carbons to move through the intermediary of a double-thread screw, A, and two nuts, B C, which carry the carbons. Lastly, D is a regulating screw, for the purpose of raising or lowering the luminous focus.

The current passes from the positive pole of the generator to the negative pole by three derivations, one of which includes the arc and traverses the ring by means of the contact-pieces *m n*; whilst a second, also including the arc, excites the electro-magnet E (or both electro-magnets in a given direction); and a third which, without passing by the arc, influences the high-resistance magnet E_1 (or both magnets in contrary directions), so that the action of this magnet upon the ring shall be in a reverse direction to that of E.

In consequence of this arrangement the action of the electro-magnets upon the ring K is almost *nil* when the arc possesses its normal resistance; but when the resistance of the arc augments the action of the electro-magnet E becomes weakened, allowing E_1 to preponderate, and the ring K will rotate so as to bring the carbons into closer proximity. The contrary effect will, of course, be produced if the resistance of the arc should diminish.

Experience has shown that with such a lamp it is possible to obtain, with regularity and safety, a good electric light with twenty-four Bunsen cells, and at first with even twenty cells. Some of these lamps have been in use in the Russian artillery

* This is somewhat obscure; what is meant, perhaps, is that the sum of the currents traversing the two magnets is, with the adjustments adopted, a constant value.—Ed. *E.*].

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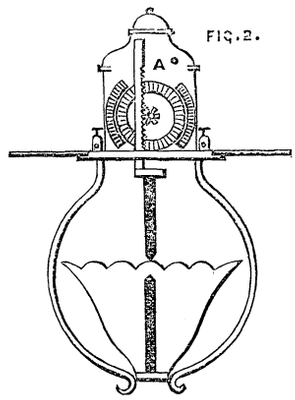
since 1877. This lamp may also be constructed on the principle of the Wheatstone balance.

The form of my lamp intended for public lighting is represented by Fig. 2. The rod A, with the upper carbon-holder,

FIG. 2.



works by the effect of its own weight. When the current traverses the lamp the distance between the two carbons is maintained by the aid of helical coils, but these coils and the toothed wheel which controls the movements are worked, as in the former case, on the principle of derivations. When the current is interrupted, the carbons come into contact by the effect of the weight of the rod A.

I omit here certain details of construction which are of importance in order that the lamp may work properly.

To sum up, the advantages of my lamp may be enumerated as follows :—

1. Its construction is extremely simple, it is free from clockwork mechanism, springs and electrical contacts.

2. It does not require preliminary regulation nor any manipulation before or during its working.

3. Several of these lamps may be arranged in series in a circuit, and they are always in due relation with the intensity and the tension of the current which is to act upon them.

4. The lamp can work with comparatively weak currents, and also produce a very powerful light when the power of the current is augmented.

I am convinced that the problem of the divisibility of the electric light by means of lamps having a voltaic arc can be solved only with the lamps based on the principle of the derivation of the current, which I discovered prior to Messrs. Lontin and Siemens.

Lamps with movable carbons offering a certain resistance between their polar extremities are moreover far preferable, from the point of view of divisibility, to lamps with fixed carbons (? with carbons at a fixed distance) which may offer great variations in the resistance of the arc, in consequence of impurities, the action of the wind, &c. These variations may in fact be greatly reduced in the former description of lamp, and it is not neessary with them to employ currents of snch high tension, or, if such currents be employed, additional lamps may be inserted in the circuit. W. TCHIKOLEFF."

PHYSICAL SOCIETY.

JUNE 26.—Professor W. G. Adams in the chair.

CONDUCTIVITY OF LIQUIDS.

Mr. C. V. BOYS read a paper by Professor Guthrie and himself on the measurement of the conductivity of liquids by means of magneto-electric induction. The liquid is suspended in a glass vessel by a fine iron wire in the centre of a cylindrical electro-magnet formed of two semi-circular parts. This electro-magnet is rotated at a velocity not exceeding 3,000 turns per minute, and the liquid being drawn round in the direction of rotation, the wire is subjected to torsion which, under correction for certain errors, is proportional to the resistance of the liquid. The torsion is observed by means of a scale and microscope. The results plotted in a curve agree very closely with those of Kohlransch, obtained by alternative currents, and Dr. Guthrie thinks that they are probably more correct and trustworthy than Kohlransch's, for the method would seem to be superior, and the curve contains fewer eccentric points than his.

REFRACTION EQUIVALENTS.

Dr. GLADSTONE read a paper on the "Refraction Equivalents of Isomeric Bodies," in which he described the present state of the subject, and his own contributions to it. He showed that the refractive power of bodies over light was of great importance to chemists since it depended on their essential structure.

STAR SPECTRA.

Dr. HUGGINS described his latest results of star spectra, and illustrated his remarks by photographic spectra taken by his improved method. From these it appears certain stars, such as Lega, give a complete spectrum of hydrogen. Others, more yellowish in colour, show a thinning of these lines such as Sirius, Ursæ Majoris. Others show the intrusion of more refrangible lines, for example Arcturus, Aquila, Virginius; while Capella gives a complex spectrum like that of the sun. Dr. Huggins also showed a spectrum of the flame of a spirit lamp which presented a strong group of lines at S, and he considered it to represent the light emitted by the molecules of water. He further observed that the spectrum offered a highly sensitive test of the presence of carbon.

FIRE-DAMP INDICATOR.

Mr. LIVEING exhibited a new fire damp indicator, capable of detecting ¼ per cent. of marsh gas in air. It is based on the fact that an incandescent body shows more brilliantly in proportion to the amount of marsh gas in the air, and consists of two fine platinum wires kept incandescent by a magneto-electric current sent through them in one circuit. One wire is excluded from the fire damp, the other is exposed to it, and the relative intensities of the two glowing wires is compared by a photometric screen placed between them, and adjustible to a position between them at which the reflections of the wires on the screen are of equal intensity. The position of the screen relatively to the wires is given by a scale and measures the proportion of fire damp in the air. This contrivance is more advantageous than the safety lamp, which only indicates 2 per cent. of marsh gas in the air.

VACUUM SHUNT.

Dr. STONE explained a new vacuum shunt for induction currents devised by himself and Dr. Keiler. It consists of a mercury barometer tube with Torriciliam vacuum and a movable cistern, suspended by a cord over a pulley and supported by a counterpoise. By raising or lowering the cistern (which is connected to the tube by an india rubber pipe) the mercury column is also raised or lowered, and the length of the vacuum, that is the resistance of the shunt, altered.

SPECIFIC HEATS.

Mr. MACFARLANE GRAY read a paper on "Specific Heats Calculated from Entropy." The author arrives at some remarkable results, which will be found in his paper in the proceedings of the society. He also explained a new graphic method of representing entropy.

Mr. CLARK communicated a paper on "The Behaviour of Liquids and Gases near their Critical Temperatures."

AIR THERMOMETERS.

Mr. WINSTANLEY exhibited two new varieties of air thermometers, and a thermograph actuated by an air thermometer on the principle of his radiograph exhibited at the last meeting. The first thermometer consists of a U tube with terminal bulbs, and the left leg of much finer bore than the right. Mercury is in the right leg, sulphuric acid surmounted with air in the left. The apparatus is a barometer to the air inside the left bulb, and a thermometer to that outside. A similar combination of an air thermometer and an aneroid barometer constitutes the second instrument. The expansion or contraction of the air in the stem by external temperature expands or compresses a small aneroid chamber in the bulb.

A CALORIMETER.

Mr. GEE and Mr. STROUD made a communication on "A Modification of Bunsen's Calorimeter," which will be found in the proceedings of the society. The meeting then adjourned till the winter session commences.

WHAT IS THE TEMPERATURE OF THE SUN?

Mr. W. E. Sawyer, writing on this subject to the *Scientific American*, says :—

"The voltaic arc affords a very ready means of comparison. The intensity of light in a good arc is fully equal to that of the sun. Therefore, the temperature of the sun is not greater than that of the arc.

"The temperature of the arc is not greater than 60,000° Fahr. Therefore, the temperature of the sun is not in excess of 60,000°; and those who have estimated into the millions have gone very wide of the mark. Rossetti's estimate of 20,000°, and Spoerer's of 27,000°, are nearer the point.

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"The light, and consequently the heat, condition of the sun can be very closely imitated in the incandescent electric light, whose temperature can be closely calculated. The voltaic arc emits light by reason of the incandescence of minute particles of carbon passing between the electrodes. In the incandescent light, so-called, the carbon is a solid mass. The dissociated particles of carbon in the arc are much more highly heated than the particles of the solid incandescent pencil, but the latter is homogenous, and therefore more like the sun. To bring a carbon pencil to that point of incandescence at which it acquires the intense limpid appearance of the sun, no longer seeming an opaque mass, but seeming transparent, it is necessary that the pencil should be heated above 12,000°. It is a veritable miniature sun, so far as the heat condition is concerned. Under no circumstances can its temperature exceed 50,000°, and the pencil even temporarily remain a solid; and even at the lower temperature volatilisation occurs. Therefore, the temperature of the sun is not less than 12,000°, nor more than 50,000° Fahr.

"There is another way of arriving at the result:—

"The diameter of the sun is said to be 800,000 miles. The earth is said to be 95,000,000 miles distant from the sun. The diameter of the earth's orbit is therefore 95,000,000 + 800,000 + 95,000,000 miles, or roughly, 190,000,000 miles. The heating surface of the sun is represented by a sphere 800,000 miles in diameter, and if we imagine the diameter of the earth's orbit to be that of a hollow sphere surrounding the sun (its inner surface situated 95,000,000 miles from the source of heat), we can approximate very nearly the difference in the degree of heat where we are and at its source. As the diameter of the sun is contained in the diameter of the earth's orbit 237·5 times—as the heat of the entire surface of the sun is distributed over a space (the space of the surface of an imaginary hollow sphere having a diameter equal to that of the earth's orbit) 237·5 times the surface of the sun—it follows that the heat of the sun at the sun's surface must be 237·5 times as great as it is at the earth's surface; and if we assume a mean of 100 degrees at the earth, the temperature of the sun must be 23,750 degrees, no more nor less, and this corresponds very nearly with what I have observed in electric temperatures."

EXPERIMENTAL RESEARCHES ON THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY.

BY WARREN DE LA RUE, M.A., D.C.L., F.R.S., AND HUGO W. MÜLLER, PH.D., F.R.S.*

(CONCLUDED FROM PAGE 71.)

Experiments were now made in air with the apparatus (already described †) shown in Fig. 1, in order to obtain a vacuum vessel

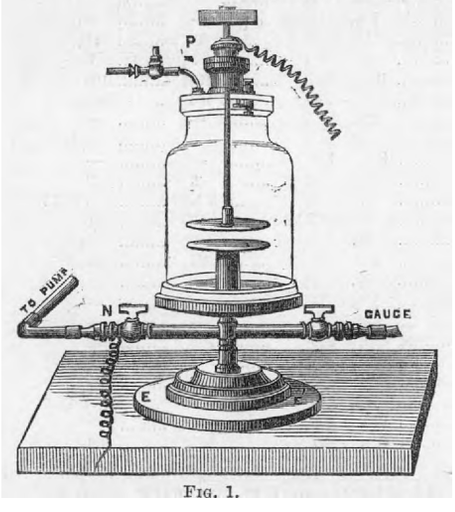

FIG. 1.

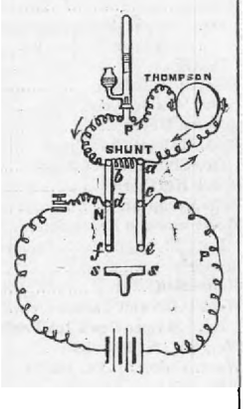

FIG. 2.

with larger terminals. The terminals are two discs a little over 4¼ inches (11 centims.) in diameter, and in the first instance were placed 3 inches (7·62 centims.) apart. Pressure 4·5 millims., 5,921 M, 2,400 cells, current, 0·04366 W., deviation on connecting the discs with the galvanometer, 10 divisions to left.

With 1,200 cells, no discharge took place, but on connecting the galvanometer a deviation of 27 divisions to the left nevertheless was produced.

At a pressure of 20 millims., 26,316 M, with 3,900 cells, no current passed, but the deviation on connecting the galvanometer, was 66·6 divisions to the left.

The discs were now placed at a distance of 2 inches (5·08 centims.), the pressure still being 20 millims., and the battery 3,900 cells; the discharge now took place, current 0·03896 W., deflection on connecting galvanometer 8·5 to left.

On reducing the battery to 2,400 cells, the discharge did not take place, but a deviation of 43 divisions was produced on pressing down *e* and *f*.

The discs were placed at 1 inch (2·54 centims.) apart, same pressure, with 3,900 cells, the current was 0·04201 W., deviation to left on connecting the galvanometer 13 divisions.

2,400 cells would not pass, but a deviation to the left of 47 divisions was obtained on connecting the galvanometer.

The following are the results of these experiments with the discs at various distances:—

Distance, inches.	No. of cells.	Pressure. mm.	Current.	Deflection on connecting galvanometer, divisions.
3	1,200	4·5	did not pass	27·0
3	2,400	4·5	passed	10·0
3	3,900	20·0	did not pass	66·6
2	3,900	20·0	passed	8·5
2	2,400	20·0	did not pass	43·0
1	3,900	20·0	passed	13·0
1	2,400	20·0	did not pass	47·0

If the fact which we have already pointed out be taken into account, that, with a constant battery potential, the difference of potential between the terminals of a vacuum tube varies, in the same gas, according to the degree of exhaustion, it follows that, as soon as a discharge takes place, the potential of the terminals will be lowered. We should, therefore, expect to find what the before-cited experiments indicated, namely, that the static charge of the terminals would be greater when no discharge takes place than after it has occurred, notwithstanding that a larger number of cells may have been employed in the latter case than in the former, for we have shown ("Phil. Trans.," vol. clxxi., p. 67), that a tube-potential may be only 430 cells, although the battery connected with its terminals is 11,000 cells.

We believe, therefore, that the experiments point conclusively to the deduction that the current obtained from the terminals of a vacuum tube, after having been disconnected from the battery, is solely due to a static charge and not to a *chemical* polarisation.

An experiment was made with the apparatus arranged differently, a tangent galvanometer being inserted in the circuit between the battery and the voltameter, the $\frac{1}{999}$ shunt being used with the Thomson galvanometer:—

No. of cells.	Current indicated by the tangent galvanometer, W.	Deflection of Thomson galvanometer with shunt $\frac{1}{999}$, on pressing down *e* and *f*.	Divisions.
1	0·00000	220 × 995·3*	218,930
2	0·00415	765 ,,	761,380
3	0·03463	984 ,,	978,820
10	0·14660	990 ,,	985,150

On keeping down the keys *e* and *f* after the voltameter had been connected with three cells, the deflection, which at first was 984 divisions, fell in—

1	minute	to 110
2	minutes	to 80
3	,,	68
4	,,	60
5	,,	55
6	,,	52
7	,,	49

so that it was evident that a current was kept up by the voltameter for a considerable time after the battery had been disconnected.

In order to render evident the direction of the current of polarisation of the voltameter the apparatus was arranged as in Fig. 2, that is, the Thomson galvanometer, with $\frac{1}{999}$ shunt, inserted in the circuit between the battery and the galvanometer. An adjustable shunt was fixed between *a* and *b* to permit the greater part of the current to pass through it. A plate of metal, *s s*, was proved to slip under *e* and *f* to short-circuit the return current from the galvanometer. The shunt, which was found just sufficient to carry the major part of the current, and yet permit sufficient to traverse the voltameter to produce a just visible evolution of gas, was 13 ohms.

On connecting the battery, the current was in the direction of the lower arrow, and the deviation 133 divisions say to the left.

* Abstract of a paper presented to the Royal Society.

† "Phil. Trans," Vol. clxxi., p. 75.

* The value of the $\frac{1}{999}$ shunt.

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On pressing down the keys on to the metal slip placed under them to short-circuit the current, after the battery had been disconnected, the return current was in the reverse direction, as shown by the upper dotted arrow, the deviation being 425 divisions to the right. Even without pressing down the keys on to the metal slip nearly the same deviation was obtained on disconnecting battery as the return current then traversed the shunt from *a* to *b*.

On substituting either the bell-jar, with disc terminals, or the tube 199 for the voltameter, the deflection of the return static charge was in the same direction as the return current for the voltameter, so that, as we before stated, no inference can be drawn from the direction of the current as to its being produced by polarisation or a static charge. We think, however, that we have shown conclusively that the effect in the case of a vacuum tube is due to a static charge, and not to a polarisation of the terminals. We rest our opinion mainly on the fact that a greater deflection is produced, when the potential has not been lessened by a discharge through the tube, than that which occurs after the discharge has taken place, which, it had been surmised, might possibly produce a chemical polarisation.

LITERATURE.

Washburne's Cable and Telegraphic Manual and Error Detector. By Messrs. WASHBURNE AND PALMER. [Globe Stationery and Printing Company, 89, Liberty-street, New York.]

The authors of this little work give as their right to speak with authority on the subject a practical experience of thirteen years in working cables and land lines. From what we gather in reading the book we can for once safely say the authors were justified in writing it, the information and the advice given being very good. The work gives, in the first place, certain information relating to charges, counting, &c., followed by some excellent paragraphs on errors and methods of detection. The following may be given as an example of the authors' matter:—

WRITING ERRORS.

Most of the errors in telegrams are caused by the indistinct writing of the original message especially in the following letters:

Small a not joined at the top is taken for u, as in adder, udder.
Capital B with bottom curve indistinct is taken for capital R: Rook, Book.
Small b with bottom curve indistinct is taken for l: barking, larking.
Small c with badly formed top curve is taken for e: caves, eaves.
Capital D with top curve not joined is taken for capital L: Doomed, Loomed.
Small e not looped is taken for small i: bell, bill.
Capital F uncrossed is taken for capital T: Fame, Tame.
,, H without bottom loop is taken for capital W: as Watch, Hatch.
Small l without loop is taken for t or vice versa.
,, n indistinctly written is taken for u or vice versa.
,, o unjoined at top is taken for v: oat, vat.
cv, e made without loop is taken for w: evade, wade.
rv in the middle of a word is taken for w: as in serving and sewing.
Small z indistinctly written is taken for g: zig, gig.
,, q ,, ,, ,, ,, g; quilt, guilt.

SOUND ERRORS.

On cables, sound errors are easily made, owing to the fact that two operators are required in working the mirror (an instrument used on cables), one reading the reflections or signals, and the other writing them down.

The following are the most likely to occur:

SOUND.		SOUND AND TELEGRAPHIC.	
Arm	for harm	Brink	for Drink
by	,, buy	Drawling	,, Brawling
Bleachers	,, Preachers	Darker	,, Barker
Bitters	,, Bidder	raydays	,, Laydays
Cowherd	,, Coward	rail	,, fail
Damish	,, Danish	Sold	,, Hold
Disport	,, Distort	rink	,, link, &c.
Grim	,, Brim		
jumping	,, Pumping		
May	,, bay		
Sandal	,, Scandal, &c.		

We have information how to detect errors, hints to code compilers, tariffs, specimen code, &c., all worthy of attention, and we trust the many users of cables may be sufficiently interested to read this work.

ABSTRACT OF PATENTS.

4346. GALVANIC BATTERIES, *R. C. Anderson.—Dated 24th October*, 1879.—(*Void.*) 2*d.*

For a two fluid battery, the ordinary positive and negative elements are employed, such as zinc and carbon, the former of which may be acted upon by any suitable acid or a salt of an acid, but for the latter or negative element is employed nitric acid or a nitrate with chromic acid or a soluble salt containing chromic acid, to which is added muriatic acid or an acid which will produce equivalent results.

4354. ELECTRIC LAMPS, *A. S. Hickley.—Dated 25th October*, 1879. 6*d.*

The "arc" is produced between a circular disc or ball electrode and a pencil-shaped electrode, which are carried upon two arms substantially parallel, standing out from a plate or framework, said arms also acting as brackets for carrying the coil or coils and other parts for conveying the electric current or currents.

4404. ELECTRIC BATTERIES, *A. V. Newton.—Dated 29th October*, 1879.—(*A communication*). 6*d.*

An outer vessel is employed, which consists of two cylinders of about equal depth, but of different diameter, joined together end to end. The lower half of this vessel has the smaller diameter, and constitutes the bottom of the vessel. The annular portion which joins the two cylinders together constitutes an annular gutter, and forms a support for a cylinder of zinc, which is attached by cement to the upper half of the vessel.

4405. ELECTRIC LAMPS, *A. V. Newton.—Dated 29th October*, 1879.—(*A communication.*) 6*d.*

In constructing a pedestal lamp a carbon block carried by a central rod is used for a series of carbon electrodes, arranged around the rod to butt against. These carbon electrodes float in mercury tubes inclining towards a common centre, and carried by brackets secured to the top of the pedestal of the lamp, and they are insulated therefrom. The carbon block is adjustable on its supports, and the tendency of the mercury in the tubes is to hold the electrodes in contact with it. The electrodes are arranged preferably to act in pairs, and in the space within the ring of tubes is a clockwork movement to bring the pairs successively within the electric circuit.

4436. PRODUCING ALUMINIUM BRONZE, *J. Webster.—Dated 31st October*, 1879. 4*d.*

A piece of sheet copper has deposited on it a coating of aluminium, and is melted and mixed with one per cent. of an alloy consisting of 20 parts nickel, 20 parts copper, 53 parts tin, and 7 parts aluminium.

4440. TELEPHONES, *J. H. Johnson.—Dated 31st October*, 1879.—*(A communication.)—(Not proceeded with.)* 2*d.*

A superexciting plate of soft iron is arranged behind the vibrating metallic diaphragm at a very short distance from the latter, whereby the sounds emitted are more intense and more distinct than in telephones of ordinary construction.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES JUNE 30.		BUSINESS DONE WEEK ENDING JUNE 30. Highest.	Lowest.
Anglo-American Ordinary	61¾,	62¼	62¼	61¾
Do. "B"	92,	⅛	92⅛	91⅞
Do. "A"	33¾,	34¼	34¼	33⅝
Brazilian	8 7-16,	9-16	8¾	8 9-16
Cuba	9¼,	⅜	9 11-16	9 11-16
Do. Ten per Cent. Pref.	15⅛,	16⅛	—	—
Direct Spanish	1⅜,	2⅛	—	—
Do. Ten per Cent. Preference	10⅜,	11⅜	—	—
Direct United States	11½,	½	11½	11½
Eastern	9,	⅛	9⅛	8⅞
Do. Six per Cent. Debenture	103,	105	104½	104
Do. Five per Cent. do. 1899	103,	105	105	105¼
Do. Six p Ct. Preference	12⅜,	⅜	—	—
Eastern Extension	9⅛,	¼	9½	9 1-16
Do. Six per Cent. Deb.	107,	110	—	—
German Union	8¾,	9⅛	9	9
Globe Telegraph & Trust	6,	⅛	6 1-16	5 15-16
Do. Six p Ct. Preference	11 15-16,	12 1-16	12⅛	11
Great Northern	9⅛,	¾	9⅞	9⅝
Indo-European	23,	24	23	23
Mediterranean Extension	2⅜,	3¼	—	—
Do. Eight per Cent. Preference	10⅜,	11	—	—
Reuter's	9⅛,	10½	—	—
Submarine	230,	240	242	242
West India and Panama	1½,	⅜	1⅜	1½
Do. Six per Cent. 1st Preference	7⅜,	¾	—	—
Western and Brazilian	6⅞,	7	6 15-16	6 13-16
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	104½	104

TRAFFIC RECEIPTS FOR MAY, 1880.

COMPANIES.	May, 1880.	May, 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,900 estd.	3,108	—	208
Direct Spanish Telegraph Company	1,334 estd.	984	350	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,963	38,371	4,592	—
Eastern Extension Telegraph Company	26,570	25,845	725	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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SLIP

ANGLO-AMERICAN TELEGRAPH COMPANY. — An interim dividend at the rate of 4 per cent. per annum has just been declared for the quarter ending June 30 last, placing £37,000 to the renewal fund.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY. — Sir Edward Watkin leaves the chair of this company, and Mr. Mendel, of whom Sir Edward spoke in the highest terms at the late Manchester meeting, takes it. Sir Edward retains a seat at the Board.

A NEW ATLANTIC CABLE.—The Telegraph Construction and Maintenance Company's ss. Seine sails from the works at Greenwich to-day with a section of the new cable for the Anglo-American Company. The ss. Kangaroo and Scotia follow with the remaining sections on the 20th of July.

SOUTH AUSTRALIA.—A TELEPHONIC FEAT.—A remarkable instance of telephony is exciting considerable interest throughout the colony, and amongst the scientific world in particular. By means of an improved telephone the Adelaide Post Office chimes have been clearly heard at Port Augusta, a distance of 240 miles.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED). —The number of messages passing over the lines of this company during the month of June was 2,653, estimated to produce £2,700, against 2,104 messages, producing £2,425 in the corresponding month of last year. The traffic receipts for the month of April, estimated at £3,100, realised £3,139.

THE WESTERN BRAZILIAN CABLE.—The Western and Brazilian Telegraph Company beg to give notice that telegraphic communication has been restored between Montevideo and Buenos Ayres, and that the extra rate of 1f. 50c. which has lately been charged is now discontinued. The messages for the West Coast of America are still being forwarded by way of Concordia, and the extra charge of 1f. 50c. still applies.

EASTERN TELEGRAPH DIVIDENDS.—The Eastern Telegraph Company announce their usual dividend of 2s. 6d. per ordinary share, making, with a previous payment on account, a dividend for the year ending the 31st March, 1880, of 5 per cent. on the ordinary shares, and carrying to the reserve fund a balance of about £79,000. The amount carried to reserve in March, 1879, when the same dividend was paid, was £16,876. More than four times that sum is now added to the reserve, which must aggregate £260,000, and is, therefore, quite a substantial figure.

NEW ELECTRICAL JOURNAL.—The first number of a journal, to be published fortnightly, in the Russian language, makes its appearance this month. It is entitled *L'Electricité*, albeit this name has already been appropriated by one of our *confrères* in France. The journal is to be edited by the sixth section of the Société Impériale Technique Russe, at St. Petersbourg; and its staff includes the names of MM. Alexeeff, Bouliguine, Wladimirski, Voskresenski, Derevian-kine, Crestin, Latchinoff, Lodiguine, &c. The titles of the articles are given in French as well as in Russian.

THE SYDNEY EXHIBITION.—We find the following among the awards made at this Exhibition:—Group (scientific and philosophical instruments and methods, classes 307—312). Great Britain: Sax, Julius, London, electric bells, telephones, presses, pulls, first award. Telegraphic Construction and Maintenance Company, London, specimens of electric submarine cables, special award. J. Taylor and Sons, London, inferential meter, second award. New South Wales: F. M. Bladen, Sydney, telephones, second award. Victoria: John Edward Edwards, Melbourne, microphone transmitters, first award. John Edward Edwards, Melbourne, telegraphic apparatus and electric bells, &c., third award.

NEWS FROM AUSTRALIA IN FIVE HOURS.—The telegram conveying the first news of the capture of the Kelly gang of bushrangers was despatched from Sydney at 12:30 p.m. (Sydney time) on the 28th ult., and reached London at 7:33 a.m. (Greenwich time) on the same day, and was published in the second edition of *The Times* on that day. Allowing for the difference of time between Sydney and London—Sydney being 10 hours and 5 minutes in advance of Greenwich time—the actual time occupied in transmission was 5 hours and 8 minutes; thus enabling events at the Antipodes to be published in the London morning papers on the day of their occurrence. This speaks well for the organisation of the Eastern and Eastern Extension Cable Companies.

CITY COMMISSION OF SEWERS.—On Tuesday a meeting of the City Commission of Sewers was held at the Guildhall for the despatch of business, Mr. Rudkin, the chairman, presiding. The Streets Committee brought up a report on the reference to them of the 16th of March last to consider as to the adoption of improved means of lighting the streets of the City. They stated that the Bridge House Estates Committee of the Corporation were desirous that the three City bridges —London, Southwark, and Blackfriars—should be lit by electricity, and, that being so, they were prepared, as an experiment, to suggest the lighting of certain streets in the City by electricity at the same time—viz., Queen Victoria-street, Queen-street and Queen-street-place, King William-street, Mansion House-street, the Poultry, Cheapside, Ludgate-hill, Ludgate-circus, the north side of St. Paul's Churchyard, and New Bridge-street, Blackfriars, together with the three bridges. They recommended, however, that before the experiment was undertaken, tenders should be invited with a view to ascertain the cost. Mr. Innes moved the adoption of the report, stating that the experiment in electric lighting upon the Holborn-viaduct was thoroughly successful as far as it went, but the cost was excessive. Since then, however, the Board of Works had carried on a similar experiment upon the Embankment and Waterloo Bridge, and had contrived to reduce the cost of lighting, and there was reason to hope that the expense might be still further decreased. The Corporation had expressed a wish that their three bridges might be lit by electricity, and that being so, the Commission had determined to extend the trial by taking in all the important streets leading to the bridges. First of all they would receive the tenders and submit them to the Court. Mr. Deputy Lowman Taylor said that while they were all agreed as to the expediency of lighting the City as well as possible, they must yet have some slight regard to its cost. He believed that the electric light had not attained any stage of perfection, and that it would be well not to take any but an experimental step in regard to it at the present time. Mr. George Shaw and Mr. R. Cox spoke strongly in favour of the electric light, and eventually the report was carried.

A COW CHARGED WITH ELECTRICITY.—Mr. W. Woods, F.R.C.V.S., Wigan, writes to the *Veterinary Journal* as follows:—"On February 21 last I was requested to visit a dairyman's cow which had calved the previous night, the owner stating that he did not understand what was the matter with the animal, as every time he touched her a trembling sensation ran up his arm, and he involuntarily

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twitched it away. He seemed perfectly astounded, and kept impressing it on me that he was not afraid of the cow, but he could not help skaking when he touched her. I visited the cow. When I placed my hand upon her, I received a perfect electrical shock, the animal evidently receiving the same, for as often as she was touched by anyone she bellowed, and jumped forward apparently terrified. The pulse and temperature it was perfectly impossible to ascertain. The owner was unable to milk her, as she went almost wild when touched, but was perfectly tranquil when not meddled with, with the exception of a wild look about her eyes. No matter how many times the animal was touched, the same result followed. With great difficulty I administered a strong saline purgative, combined with fifteen croton beans, followed in a few hours by a pint of linseed oil containing a small quantity of chloroform. At night the cow was considerably better, and the following morning I was pleased to find her quite convalescent."

The Edison Lamp.—The following results of the experiments made by Professor Henry Morton and Messrs. A. M. Mayer and B. T. Thomas on Edison's "cardboard" lamp are of considerable practical importance:—The resistance of the horse-shoe shaped carbon whilst in its incandescent condition was 75·5 ohms; when cold its resistance was as high as 114 ohms. The current traversing the carbon was 1·079 webers per second, its mechanical value being ·116 horse-power for each lamp. The maximum luminous effect under these conditions was 20·6 standard candles; the mean value being 14·26 candles. Allowing a loss of 40 per cent. in the conversion of mechanical into electrical energy, one horse-power would maintain in action five lamps, each having a mean illuminating power of 14·26 candles, or a total of about 70 candles. These figures alone are sufficient to condemn the Edison lamp; for the worst of regulator lamps would give twenty times the illuminating power (in one focus) for an equal expenditure of power; and even the Regnier, or Werdermann lamps, under the most unfavourable conditions, would afford six or eight times as much light as the Edison lamp under the best conditions. The defective result is sufficiently accounted for by the combination of two conditions which are most detrimental from an economical point of view, viz.: a comparatively low temperature and large radiating surface.

South Australia.—The annual report of the President of the Marine Board of South Australia contains several paragraphs tending to show the increased benefits to be derived from telegraphy and the electric light in furthering safety to vessels and early communication. Lighthouses:—"A light of the best description procurable is required for Cape Northumberland, which is a most important turning point on our coast-line, and should be provided with an electric or other first-class light without unnecessary delay, especially as doubts have been expressed as to the stability of the lighthouse. The Board visited the Cape in August last, and recommended that a fixed electric light should be placed on a spot about 700 yards N.E. by E. from the present lighthouse (this alteration in the site would not practically affect navigation), and that the present light be removed to Cape Banks, between Rivoli Bay and MacDonnell Bay, where so many shipping casualties have occurred. The Engineer of Harbours also visited the site, and estimated that a first-order fixed dioptric light, with stone lighthouse and cottages, would cost £6,750, or if built of wood £6,500. His estimate for an electric light in a tower forty feet high, including four cottages, the magneto-electric machinery, engine, boiler, &c., would cost £20,000, and necessitate an annual expenditure of about £1,500. The present optical apparatus might be utilised by erecting it on Cape Banks. Sturt Lighthouse, Kangaroo Island, will shortly be connected by telegraph with Kingscote, and masters of vessels approaching Cape Willoughby will then be able to communicate with the city or any part of the world. It is also most desirable to have telegraphic communication with Althorpe Island. In my report for 1878 I suggested a route, and recommended that the Superintendent of Telegraphs should be consulted, but have not heard whether any steps have been taken in the matter. A signalman has been appointed at Cape Borda, Kangaroo Island, by the Telegraph Department, as it was found impossible for the lighthouse keepers to properly attend to the signalling of ships and carry out their ordinary duties as well."

The Electric Light in Bombay.—The office of our contemporary, the *Bombay Gazette*, is now successfully lighted by electricity. When the preliminary trial was made, says the *Gazette*, the result was found to be so satisfactory that we determined to use this beautiful light in the composing and machine rooms, and steps were taken to procure the additional motive power necessary. To drive the printing machines of the office an ordinary three or four horse-power engine was sufficient, and an engine of the same capacity would have been sufficient to drive the Gramme magneto-electric machine. It was deemed better to get an engine able to drive both at once, and with plenty of power to spare, so as to allow of future developments. One of Robey's semi-portable engines of eight horse-power was selected. The engine up, M. Verne, the chief engineer of the Indian Electric Light Company (Limited), a branch of the Société Generale d'Electricité of Paris, put up one of Gramme's eight-light magneto-electric machines, and made the connections with two lights in the composing room, one in the machine room, and one at the entrance. This leaves a reserve of four lights, which may be used hereafter if required. The connections made and steam up, the turning of a handle flooded the composing room, the machine room, and the entrance in the brightest and purest light, each lamp having the photometric value of fifty ordinary gas-jets. Every evening since the light was first used it has been turned on and used in the same way without trouble. There is abundance and superabundance of light, and the heat and vitiation of the atmosphere inseparable from the use of all other systems of illumination are entirely done away with. The Jablochkoff candles are used for the conversion of the electricity into light. The Société Generale is at present making arrangements with the Maharajah of Cashmere to light Jummoo with electricity. As a preliminary, His Highness's palace will be lighted up, and if all goes well the city, or at least its principal quarters, will be lighted. The light is in use at Rangoon in several rice mills, and in the private house of one gentleman. The company was employed by Sir Richard Temple to light the bridge-makers at Jhelum and elsewhere at night on the Candahar line.

On the Influence of Atmospheric Electricity on Long Underground Telegraph Conductors.—There is no doubt about the fact that atmospheric electricity affects subterranean lines, and this occurs through the discharge of thunderclouds or similar causes producing currents in the earth over the wires, and also because the underground wires, having the same earth connections at the end as certain overhead wires coming to the same offices, are affected by the disturbances in these wires. The German telegraph administration made last summer a series of inquiries as to how far these disturbances affect the work of the great underground

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conductors of the empire, and they have found that in the underground system the disturbance is very much less than in the overhead system. Again, they found that on the underground system disturbances showed themselves to be stronger in the Hughes system than in the Morse. In the Hughes, false signals occurred, single letters and even whole words being omitted, whereas in the Morse only a few signals were slipped. The disturbances were especially great when thunderstorms burst over the places where the lines went to earth; but, indeed, the disturbance was always great immediately underneath discharging thunderclouds, even when there was no earth connection, and they seemed to be as great whether the thunderstorm crossed the line or went along the line. Lastly, when disturbances occurred near one end of the wire going to earth, very little effect was seen at the other. During a very severe thunderstorm which showed itself at one end of the line, and produced frequent and strong discharges, the whole apparatus attached to the overground system was so much affected that messages could not be sent, but although the thunderstorm was moving in the direction of the underground wires so little disturbance was observed on them that the work went on in the usual way. Suddenly, however, a Morse instrument attached to one of the underground wires stopped working, and was found to be damaged, and a horse in a building about five mètres from the underground wire was also hurt by the shock. But it was found that this underground wire was connected with earth by the same copper wire which served for several overhead lines, and on one of these overhead wires a galvanoscope was simultaneously injured. The injury on the instrument attached to the underground wire really arose from the same wire being used as an earth lead for both the underground and the overhead systems.—Abstract of a paper *(Journal of the Society of Telegraph Engineers)* by Herr Massmann, in *Electrotechnische Zeitschrift*, H. III., March, 1880, pp. 93, 94.

Determinations of Longitude.—At the recent meeting of the National Academy of Sciences, at Washington, Lieutenant Commander F. M. Green, U.S. Navy, read an interesting report on the progress made by the United States Hydrographic Office in establishing, by the use of telegraph cables, a general system of secondary meridians of longitude. Geographers and chart-makers have been and are still greatly embarrassed by the difficulty of harmonising the different values assigned to the longitudes of nearly all points on the earth's surface outside of the United States and Europe. The English Hydrographic Office has selected fifty points at intervals, and assigned to each an arbitrary longitude, and on these positions their charts are constructed, but they do not harmonise, and many of them vary widely from the truth. The French Government has sought to establish a similar set of positions by observations of moon culminations, but the results are not satisfactory, and experts are agreed that where telegraphic communication exists, no method of determining longitudes equals, for accuracy and simplicity, that known as the American method, which consists in comparing, by means of the electric telegraph, two time-pieces, one situated at each end of the line, and the errors of which on local time are determined by astronomical observations. In this way differences of longitude are first measured from the initial meridian, and then from the places so determined, step by step. In 1873 the United States Hydrographic Office commenced this work, measuring step by step from Key West through the West India Islands to Panama on the West and Port Spain on the east, fitting out two parties, each with portable observatory, transit instrument (with zenith telescope attachment), break-circuit chronometers and telegraph instruments. Thirteen positions were exactly established in this way in 1874 and 1875. In 1877 and 1878 a similar chain of measurements was extended by Lieutenant Commanders F. M. Green and C. H. Davis, United States Navy, from Greenwich Observatory, by way of Lisbon, Madeira, Porto Grande, Pernambuco, Bahia, Rio de Janeiro, and Monte Video, to Buenos Ayres, there connecting with the chain of exact measurements made by Dr. B. A. Gould at Cordova, extending to Ascension, Santiago, and Valparaiso. An interesting feature of this measurement was the demonstration that the Royal Observatory at Lisbon, and indeed the whole coast of Portugal, should be laid down two miles further to the westward than has before been done. Altogether twenty-one positions on foreign coasts not heretofore exactly established have been determined with all possible accuracy, but a great deal remains to be done. The Russians have carried a measurement by similar means across Siberia, terminating at Wladiwostok, and the engineers of the great Trignometrical Survey of India have measured from Greenwich, through submarine cables, to Bombay and Madras. The chief of the Bureau of Navigation, Commodore W. D. Whiting, is very desirous to join the points of Wladiwostok and Madras by a measurement through the cables along the coasts of Japan, China, and Malasia. This will give ten more exact points. Another important piece of work will be to measure from the Coast Survey Station at Brownsville, Texas, by the lines of the new Mexican Cable Company, to Tampico and Vera Cruz; then across the Isthmus of Tehuantepec along the coast of Central America to Panama and Guayaquil. By this measurement, nine or ten more secondary meridians would be added to the list, and as soon as the war ceases between Peru and Chili, ten more can be added by the use of the line along the west coast of South America. A cable also connects the general East India system of telegraph lines with Zanzibar and South Africa. This measurement will probably soon be made by the authorities of the Observatory at the Cape of Good Hope, and upon its result will depend the longitudes of a great part of the east and west coasts of Africa, as well as the numerous islands of the Indian Ocean. These meridians once established, subsidiary chronometric measurement from them becomes an easy matter, and the present discordance between different lists of geographical positions will no longer exist. The following longitudes of places in the West Indies were determined by telegraph by Lieut.-Com. F. M. Green, U.S. Navy, in 1875:—Havana (Morro Lighthouse), 23° 9′ 20″·98 N. lat., 82° 21′ 30″ W. long.; Santiago de Cuba (south angle of Blanca Battery), 20° 0′ 16″·4 N. lat., 75° 50′ 30″·15 W. long.; Kingston (Port Royal flagstaff), 17° 55′ 55″·8 N. lat., 76° 50′ 37″·8 W. long.; Aspinwall (the Lighthouse), 9° 22′ 8″·8 N. lat., 79° 54′ 44″·7 W. long.; Panama (S.E. angle of south tower of Cathedral), 8° 57′ 6″·15 N. lat., 79° 32′ 12″·3 W. long.; San Juan de Piærto Rico (the lighthouse), 18° 28′ 55″·86 N. lat., 66° 7′ 27″·75 W. long.; San Thomas (S.W. angle of Fort Christian), 18° 20′ 23″·15 N. lat., 64° 55′ 52″·5 W. long.; San Croix (Lang's Observatory, centre of transit pier), 17° 44′ 42″·7 N. lat., 64° 41′ 17″·4 W. long.; St. John, Antigua (north tower of Cathedral) —, 61° 50′ 27″·9 W. long.; St. Pierre, Martinique (upper light, St. Marthe Battery), 14° 43′ 53″·9 N. lat., 61° 11′ 11″·7 W. long.; Bridgetown, Barbados (flagstaff of Rickett's Battery), 13° 5′ 42″·5 N. lat., 59° 37′ 18″·45 W. long.; Port Spain, Trinidad (flagstaff of Water Battery), 10° 38′ 39″·21 N. lat., 61° 30′ 38″·4 W. long.—*Nautical Magazine.*

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REPORT.

The Eastern Telegraph Company has declared the usual dividend, and places a good sum to the reserve. This is as it should be, and the shareholders are to be congratulated.

The Anglo-American Company will, in all probability, have another Atlantic cable laid before many days are past. As we stated last week, the heavy traffic brought to this company through the reduction of tariff has been transmitted with the utmost regularity and despatch. An additional cable will, however, render the management free from the care and anxiety which must come should any hitch occur. The Telegraph Construction and Maintenance Company have the work of the new cable in hand, and from the great experience of this company, and its undeviating round of success, we may be sure that no foresight or pains will be spared in laying this new cable. We have long passed the time predicted by Lord Palmerston that the day would come when, if a minister were asked in Parliament whether war had broken out in India, he would reply, "Wait a minute. I'll just telegraph to the Governor-General, and let you know." It is no extraordinary thing on certain festive occasions to have wires connected with America, or India, or even Australia, and to send a message and obtain a reply during the process of dining. We must not forget that the Anglo-American Company was the pioneer of Atlantic telegraphy.

It may be interesting to some readers to know that *The British Almanac and Companion* for the years 1858, 1866, and 1867 contains articles on the work of laying, grappling, &c., of the first Atlantic cables.

In a recent number we noted that Mr. Edison had patented an electro-magnetic ore separator. The following shows that the idea is by no means a new one. "A device absolutely identical with this," says Mr. R. D. Williams, in a letter to the *Scientific American*, "has been in use for the past ten or fifteen years at the emery works at Chester, Hampden county, Mass. I there saw it in use myself in November, 1876, and was informed, I think by Mr. Ames, that it was not patented, and that no valid patent could be granted upon it by reason of its long continued public use. My uncle, John S. Williams, of this city, president of the Ore Knob Copper Company, had heard of the machine, and sent me to Chester with a view to purchasing the right to use it at the Ore Knob Copper Works, in Ashe County, North Carolina. On my return to Baltimore I had the magnets constructed by Watts and Co., electricians, on November 24, 1876, for a large machine, similar to the one at Chester, which machine was completed about December 10, 1876, and practically tested at No. 52, Commerce-street, Baltimore. It was sent to the Ore Knob Mine about Christmas, 1876, to be used in separating magnetic oxide of iron from the copper ore, and, for aught I know to the contrary, is in use there yet. This is a striking instance of how history repeats itself in inventions. Mr. Edison is doubtless an original inventor of the device, but he most certainly is not the first inventor."

Our cousins across the Atlantic may have their example followed by some of our municipal authorities. Really the large towns would derive a fair income by adopting some such scheme as that reported from Philadelphia:—"The sub-committee of Councils Committee on Law, of Philadelphia, reported an ordinance providing that all persons now using, and who may hereafter use, the telegraph poles erected by and belonging to the city, shall pay for the privilege the sum of fifty cents for each and every attachment to each and every pole; and further, that all companies or individuals who use the poles belonging to the city shall certify to the Superintendent of the Police and Fire-alarm Telegraph Department, on or before the 15th of December annually, the number of attachments to each and every pole owned in whole or in part by the city of Philadelphia." In these days of telephone exchanges the corporation should erect poles at intervals over the borough, and charge so much per year for each wire attached. Probably by such a method the receipts not only of the Telephone Companies but the Corporations would be increased.

A PRELIMINARY ACCOUNT OF THE REDUCTION OF OBSERVATIONS ON STRAINED MATERIAL, LEYDEN JARS, AND VOLTAMETERS.*

BY JOHN PERRY AND W. E. AYRTON.

(CONTINUED FROM P. 77.)

When a beam or wire is suddenly bent or twisted, the forces producing the strain being maintained constant, it is known that the strain increases with the time, and if the forces suddenly cease to act, that the strain does not altogether disappear at once, but diminishes gradually. This strain, w, we have found can, like differences of potential and current, be most easily expressed as the sum of certain exponentials of the time. There are other analogies with condensers. Rapid tremors given to a strained body, our experiments show, cause it to attain its ultimate state more rapidly. One example of this is the more rapid soaking out of the residual charge in a Leyden jar, as noticed by Dr. Hopkinson. Our curves connecting w and t for strained beams, like those connecting v and t in condensers, or u and t in voltameters, we find to be of a slightly wavy nature, and to be all similarly affected by change of temperature. Like several other experimenters, we have found that the strain in a body at any time depends not only on the forces acting upon the body at that time, but also on all the forces which have acted on the body during all previous time; so that, for instance, if a beam fixed at the ends has been loaded negatively for some time, if this load be removed and a positive load applied and soon taken off, the beam may be found to have a negative deflection. Or, again, if a current be sent for some time through a voltameter in one direction, and then reversed for some time, and finally the battery removed, the discharge from the voltameter, through a galvanometer, will, in certain cases, first be found opposite to the latter charging current, but subsequently it will become nought, and then become the opposite of the first charging current, this experiment being best seen with electrolytes having a certain amount of rigidity. Similar phenomena are also evidenced with iron under magnetisation, and Dr. Hopkinson's experiments on Leyden jars also lead to similar results.

We have, consequently, while investigating the results we have experimentally obtained during the last few years with strained substances, been led to construct the following theory, which is analogous with that of the late Professor Clerk Maxwell for Leyden jars.

A perfect fluid is such that the only stress which can exist at any small interface which may be drawn in the fluid is a stress normal to the interface, and hence, if the fluid is contained between two parallel planes which have a motion in their planes relatively to one another, there is no force required to cause this motion, or to maintain it, in the case of a perfect fluid. If the fluid is a gas or a vapour, we can calculate the force which would be required to maintain a given relative velocity of the plates, and our students have obtained experimentally some materials (not yet published) for the calculation of such forces when the fluid is water. If the fluid is tar, or a mixture of tar and pitch, in any proportion, or even if it is the more solid substance, pitch or sealing wax, we find that, although the viscosity is almost infinitely greater than in the case of water, still the phenomena exhibited are exactly the same. And just as experiments on water enable us to examine best some phenomena exhibited by viscous substances, so experiments on sealing wax enable us to make the best examination of other phenomena.

When external forces suddenly act on a viscous fluid (and we know that all substances, whether solid, liquid, or gaseous, come under the head of "viscous fluids"), tending to cause strains in the material, we can calculate in the well-known way the strains and stresses. If the forces do not alter, and if the shape of the body varies very little with time, the stresses do not alter, but the strains increase according to a law,

$$X = r\frac{ds}{dt},$$

where X is the stress at any interface, s the corresponding strain, t the time, and r a constant. Of this strain, if the part which was suddenly produced, and which is suddenly removable, is f, then $X = kf$, k being the coefficient usually given in books to connect the corresponding stress and strain.

During the increase of strain mechanical energy is being converted into heat, through the agency of internal friction or viscosity, at the rate, $X\frac{ds}{dt}$ per unit time.

* Read before the Royal Society, May 27.

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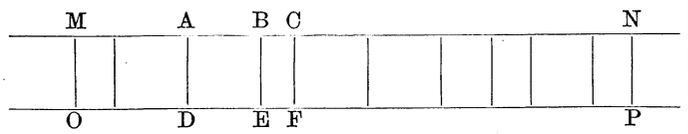
If the external forces are not kept constant the stresses X alter, and also the strains. The second relation given above remains the same, but the first becomes

$$X = r\frac{d}{dt}(s-f).$$

Now, the first and last relations constitute our hypothesis. We have arrived at it by analogy, and not yet by experiment. We know that for the motions of pendulums, &c., in air, this law holds, and as the velocity, or $\frac{ds}{dt}$, is less and less, the law is found to be more and more true. For the motion of steamships it is usual to assume the law—

$$X = r\left(\frac{ds}{dt}\right)^n,$$

where n varies from 2 to 2·28, but as motions in water become slower and slower, n becomes more and more nearly equal to unity. In the following investigation, we assume that the rates of deformation of the materials, after the first instant, are so slow, that n always equals unity. Our hypothesis is exactly analogous with Ohm's law in electricity; and just as Ohm's law has only been proved for metallic conductors of electricity, so our hypothesis is only known to be true for gases and liquids. All the analogies which we have observed cannot be discussed in this short paper, but they are such that we are led to believe that if our hypothesis proves to be untrue for materials subjected to small strains, then Ohm's law will prove untrue for currents of electricity in bad conductors. It will be seen that it leads to the conclusion that, just as there are no perfect insulators of electricity, so no material, however rigid it may appear to be to us, can for an infinite time resist the effect of even small forces tending to change its form.



Let M N O P be a large prism of unit square section, formed of blocks of different materials of lengths, a_1, a_2, &c. Let them be subjected to shear stress by the action of tangential force, v, distributed over the surface M N, and an equal and opposite tangential force distributed over the parallel plane O P. Let the compound prism be so long that we need not speak of the terminal couple which is required to produce equilibrium. Let f_1, f_2, &c., be the strains existing in the blocks which would be instantaneously destroyed if the stress disappeared, so that if the shear stresses in the blocks are respectively X_1, X_2, &c., then

$$X_1 = k_1 f_1 \quad \ldots\ldots\ldots \quad (8),$$
$$X_2 = k_2 f_2, \text{ &c.},$$

where k_1, k_2, &c., are the moduli of elasticity of the separate blocks. The distributed external force acting on either of the upper or lower sides of the block being of course $a_1 X_1$.

If the velocity of O P with regard to M N is u, then u is the rate at which each block is gaining strain, because the motion of O P with regard to M N is the measure of the common strain which exists in all the blocks. Consequently, by our hypothesis for any block, we have

$$X_1 = r_1\left(u - \frac{df_1}{dt}\right) \quad \ldots\ldots\ldots \quad (9),$$

where r_1 is a constant for the material of which the particular block is composed. Hence, combining (8) and (9) we have

$$u = \frac{1}{r_1}X_1 + \frac{1}{k_1}\frac{dX_1}{dt},$$

from which, by denoting in the usual way an inverse operation

$$X_1 = \left(\frac{1}{r_1} + \frac{1}{k_1}\frac{d}{dt}\right)^{-1} u.$$

The total distributed force v is, of course, equal to the sum of all the forces $a_1 X_1$, $a_2 X_2$, &c., so that

$$v = \left\{ a_1\left(\frac{1}{r_1} + \frac{1}{k_1}\frac{d}{dt}\right)^{-1} + a_2\left(\frac{1}{r_2} + \frac{1}{k_2}\frac{d}{dt}\right)^{-1} + \ldots \text{ &c.} \right\} u,$$

an equation between the force distributed over either of the parallel planes, and the rate of motion of the planes relatively to one another.

If any number of blocks are of the same material, or if, although not of the same material, the ratio of r to k is the same in them, then it is evident that for all such blocks there will only be one inverse term of the above equation. Hence, if there are n different materials having different ratios of r to k, we have the general equation

$$\frac{d^n v}{dt^n} + b_1\frac{d^{n-1}v}{dt^{n-1}} + \ldots + b_{n-1}\frac{dv}{dt} + b_n v$$
$$= c_n u + c_{n-1}\frac{du}{dt} + \ldots + c_2\frac{d^{n-2}u}{dt^{n-2}} + c_1\frac{d^{n-1}u}{dt^{n-1}} \quad (10).*$$

In the preceding we have followed Professor Clerk Maxwell's method of investigating the charge of a condenser, and the currents flowing into it, the method of reasoning from our hypothesis regarding the action of a viscous block being the same as his reasoning from Ohm's law. From the form of the equation it is evident that the order of the materials is indifferent, so that if there are several blocks of the same substance, they may be subdivided or united without altering the phenomena. An investigation of the cases in which the materials are arranged otherwise than in rectangular blocks of unit depth, would lead to similar results, and if we may assume our hypothesis to be true for other kinds of strain than shear, then the above equation may be proved to be true for any strain of any heterogeneous body strained in any way.

The integration of the general differential equation (10), where v is constant, is, putting $\frac{dw}{dt}$ for u,

$$w = A + Bt + C\epsilon^{-\gamma t} + D\epsilon^{-\delta t} + \ldots.$$

where γ, δ, &c., are roots of the equation

$$x^n + \frac{c_2}{c_1}x^{n-1} + \ldots + \frac{c_n}{c_1}x - \frac{b_n v}{c_1} = 0,$$

and when v is maintained at zero during recovery after removal of the load

$$w = A_1 + C_1\epsilon^{-\gamma t} + D_1\epsilon^{-\delta t} + \ldots.$$

Of course if complete tables of the values of u and v, and their differential coefficients, could be given for all times during any experiment, it would be best to use the general differential equation in determining the constants. The method we have adopted is essentially the same as that we have employed in the analogous cases for Leyden jars, voltameters, &c. The wavy nature of some of the curves we have experimentally obtained connecting strain and time in strained beams, indicates that perhaps the equation given above may have imaginary roots, and that possibly there may be terms in our solutions of the shape

$$C\cos.\, bt\,\epsilon^{-\beta t}.$$

Much, however, of the waviness we have observed we have traced to variations of temperature, as it generally has a periodic time equal to 24 hours.

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* If we put $m_1 = \frac{r_1}{k_1}$, &c., and let

s^r represent the sum of products of m_1, m_2, &c., r at a time,
$s^r{}_p$,, ,, ,, r at a time, but only such as involve m_p,

then the differential equation is evidently as follows :—

$$v + s'\frac{dv}{dt} + s^2\frac{d^2v}{dt^2} + \ldots + s^n\frac{d^n v}{dt^n} = \sigma u + \left(s'\sigma - \sum_{p=1}^{p=n} a_p r_p s_p'\right)\frac{du}{dt}$$
$$+ \left(s^2\sigma - \sum_{p=1}^{p=n} a_p r_p s_p{}^2\right)\frac{d^2u}{dt^2} + \ldots\ldots + \left(s^{n-1}\sigma - \sum_{p=1}^{p=n} a_p r_p s_p{}^{n-1}\right)\frac{d^{n-1}u}{dt^{n-1}}$$
$$\text{where } \sigma = a_1 r_1 + a_2 r_2 + \ldots\ldots + a_n r_n.$$

Now, if the body consists of only two substances, then we have

$$v + \left(\frac{r_1}{k_1} + \frac{r_2}{k_2}\right)\frac{dv}{dt} + \frac{r_1 r_2}{k_1 k_2}\frac{d^2v}{dt^2} = (a_1 r_1 + a_2 r_2)u + \left\{ r_1 r_2\left(\frac{a_2}{k_1} + \frac{a_1}{k_2}\right)\right\}\frac{du}{dt}$$

where v is the load on the beam or couple twisting the wire, and u is $\frac{dw}{dt}$ if w is the deflection of the beam or twist of the wire.

If v is constant, then the equation becomes

$$\frac{d^2w}{dt^2} + g_1\frac{dw}{dt} + g_2 = 0,$$

g_1 and g_2 being certain functions of a, k, and r, and the solution of this is

$$w = A + \frac{g_2}{g_1}t - B\epsilon^{-g_1 t}.$$

(TO BE CONTINUED.)

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THE ELECTRICIAN.

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EXHIBITIONS.

It was suggested a short time ago that the Agricultural Hall, so often used for exhibitions, would be a good place in which to hold an exhibition of electrical apparatus. We presume, however, that no one in London takes sufficient interest in the matter, and therefore such an exhibition will not be held. Unfortunately, the exhibitions generally suggested are such as will likely attract the public and bring in shillings to the promoters. It would be easy enough, probably, to carry out at the Agricultural Hall a scheme of this kind, where telephones, and microphones, and electric lights should be the principal exhibits, where no attention would be paid to science and scientific wants, but everything made to give place to popularity and "making it pay." At first, for a short time after the 1851 Exhibition, such schemes were praised because of the educational facilities presented by them. There workmen, said the pioneers, could compare—could see where they failed and others succeeded, where others failed and they succeeded. Exhibitions were to remedy our bad taste. Our Continental neighbours had a lighter touch and better artistic instincts; we were to imbibe the instincts and attain to the touch. The millennial period of perfect workmanship has not yet arrived. It cannot be said of this chariot that

> "Up yonder winding road it rolls along,
> Swift as the bittern soars on spiral wing,"

but rather that it "drags." Exhibitions have degenerated into big shops, and as such are useful. We are no longer troubled with accounts of the indirect returns, and unless the direct returns show a good profit, the whole concern is voted a failure. Exhibitors do not care two straws for the gold, or silver, or any other medal, or mention, except so far as it pays them to advertise their successes. The medals remain unclaimed, the reward is conspicuous in the advertisement.

Those who still think that scientific advancement may come from exhibitions are anxious for a change. The conception of the loan exhibitions at South Kensington showed this, but the failure in their management left us almost without hope. The price paid for the experience gained was far too heavy, and it is hardly possible that any government will go to the expense of another trial of purely educational exhibitions. It is indeed difficult to suggest any remedy for the existing state of things, and we certainly do not intend to make the attempt. There is, however, one suggestion we shall discuss further on, which if carried out would, we believe, be of some service. Before referring to this, we may mention that an exhibition is to be held at Glasgow during the later months of this year, and that among other exhibits there is a special group devoted to electrical apparatus as applied to telegraphy, the electric light, &c. When we mention that Sir W. Thomson is one of the vice-presidents of the executive of this exhibition, it is needless to say that the electrical department will be well represented. This exhibition is under the auspices of the Philosophical Society of Glasgow, and leads us to hope that other learned societies may follow so good an example.

We would suggest that in any exhibition such exhibits as electrical apparatus be arranged not in a stand under the name of the exhibitor, but to show the evolution of the instruments. For example, galvanometers should not be found in twos or threes on the stand of each exhibitor, but be found all together, commencing at one end of the exhibit with the earliest model, finishing at the other with the latest development of the instrument. Here it is, too, that the "educational facilities" of an exhibition should command attention, and regular demonstrations by able men be given of the apparatus shown. If it is impossible to obtain such information at an exhibition, the Society of Telegraph Engineers might well consider the advisability of devoting one or two evenings of each session to such demonstrations. Societies are not supported by those who are altogether familiar with the subject, but by many who think it pays to be able to use certain letters after one's name, and by others who have a deep and earnest desire to gain trustworthy information. The results of original research are not always understood by these gentlemen, because their knowledge of fundamental points is more or less deficient. Suppose, for example, some good lecturer were invited to discuss the development of electrical measuring instruments. He could set forth in clear and simple language the objects to be attained; he could show how the early workers strove to make instruments; he could point out where those instruments failed, and how improvement succeeded improvement, never forgetting to explain the exact value of each improvement, till finally the cycle would bring him to the children of Sir W. Thomson's fertile imagination. Are they perfect? We opine not, or there would be no alterations in the manufacture; yet changes and improvements are made, each of which would be described and weighed. A similar demonstration might be devoted to the dynamo and magneto machines, and we think the advantages derived from such a course would amply repay the trouble and expense incurred. Men are in many cases working in the dark, and the mere looking at a number of instruments, carefully locked up in a glass case, or under an embargo "Not to be touched," does not dispel the cloud of ignorance.

It may be said that all this information can be obtained from books or periodicals. It cannot. Englishmen, in any number, do not read technical articles, and will not; they do, however, go to exhibitions and meetings of societies, because it is fashionable, or "it pays."

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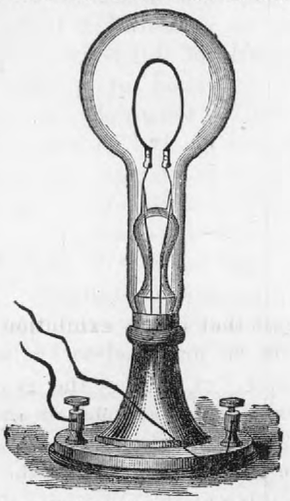
MEASUREMENTS OF AN INCANDESCENT PAPER-CARBON HORSESHOE LAMP CONSTRUCTED BY MR. T. A. EDISON.

BY HENRY MORTON, PH.D., A. M. MAYER, PH.D., AND B. F. THOMAS, A.B.*

It may seem almost superfluous to describe the carbon horseshoe electric lamp as recently constructed by Mr. T. A. Edison, so much has been written about it in journals of all descriptions from the daily papers upwards; but to make our work complete we will state briefly that the lamp measured by us, and represented in the accompanying cut, consists of a pear-shaped glass globe with two re-entering tubes at its smaller end, through which are passed platinum wires with little screw-clamps at their upper ends, which hold the ends of the carbon horseshoe.



This horseshoe is 1·18 inch high, and 0·72 inch across at the widest part.

It is made by charring a piece of thin cardboard of similar shape out of contact with air. The interior of the globe is very perfectly exhausted. Fine copper wires connect the platinum wires with the binding-screws on the wooden base of the lamp.

The present writers believe that the following measurements, made by them in the physical laboratory of the Stevens Institute of Technology, possess some general interest as being the first full and accurate series of determinations, giving the fundamental properties of one or these instruments.

The lamp in question was one of the paper-horseshoe style, No. 154, given by Mr. Edison to the editors of the *Scientific American*, and by them kindly loaned to us.

We have failed to obtain other lamps directly from Mr. Edison, seemingly because of the offence taken at Menlo Park to the emphatic contradiction which one of us thought it right to give at the very outset to the unfounded claims of Mr. Edison's lamp, which were then published by some of the daily papers.

The lamp here described is certainly a fair specimen of the type to which it belongs, as appears from a general comparison of results with those obtained by the scientific men who recently measured a number of these lamps at Menlo Park under the auspices of Mr. Edison himself.

The work herein described has been in progress for nearly two months, being frequently interrupted by the pressure of other engagements.

Our experiments naturally divide themselves into three groups:—

I. Determination of resistance of lamp as compared with luminous power and with total heat developed.

II. Determination of average of light given out by lamp in all azimuths.

III. Determination of current-strength in circuit corresponding to various intensities of luminous power in lamp and deflections of galvanometer.

With these data, the determination of relation of luminous power to energy expended in the lamp itself in producing the same was a matter of direct calculation.

I. *Determination of the resistance of the carbon-loop of lamp as compared with its luminous power and total heat developed.*—A preliminary experiment having shown that between 50 and 60 cells of a Grove battery, with active zinc surface of 20 square inches and platinum surface of 18 square inches in each cell, were required to develop the requisite electric current, such a battery was set up and connected piecemeal with the rest of the apparatus arranged as follows.

The battery-current was divided into two branches, which traversed in opposite directions the two equal coils of a differential galvanometer having ·33 ohm resistance in each coil. One branch then traversed the lamp, which was placed in a Bunsen photometer made by Sugg, of London. The other branch passed through a series of adjustable resistances composed of German silver wire, stretched in the free air of the laboratory to avoid heating (careful tests showed that this precaution fully accomplished the desired result); and the united branches were then carried to the other pole of the battery.

These arrangements having been made, a certain number of battery-cells were put in circuit and the resistances adjusted until the galvanometer showed no deflection. The condition of the loop was then observed in perfect darkness; and when its light was measurable it was taken by varying the distances of both lamp and candle as circumstances required.

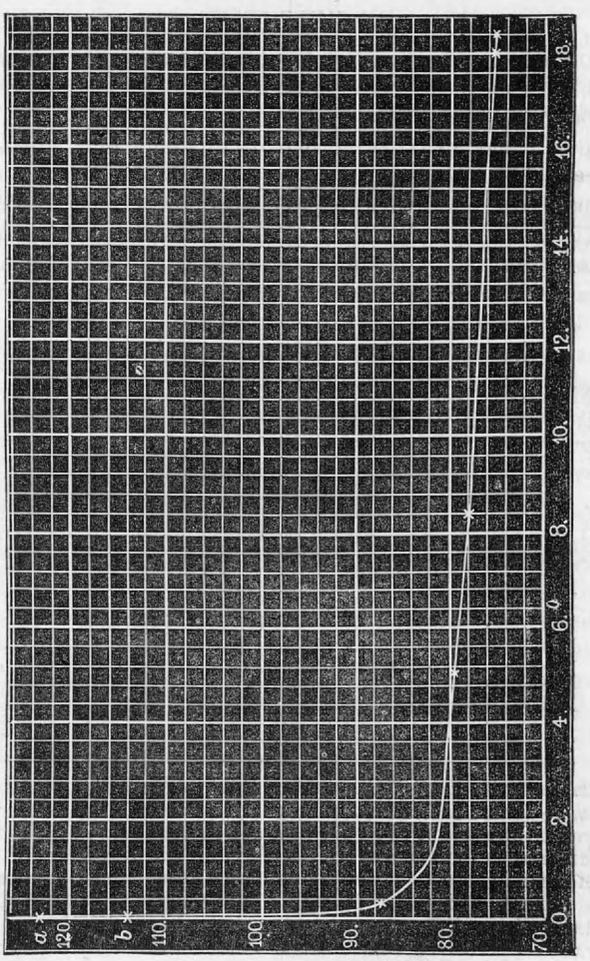
Thus, for the lowest candle-power taken, the lamp was at 15·8 inches from the photometer, and the candle at 50 inches. The results so obtained were as follows:—

No. of cells in circuit.	Candle-power.	Resistance.
0	0	123·0 ohms.
5	0	113·5 ,,
10	dark red	106·0 ,,
20	·1 candle	94·0 ,,
25	·2 ,,	89·0 ,,
30	·4 ,,	87·0 ,,
35	·9 ,,	83·7 ,,
40	1·9 ,,	82·0 ,,
45	5·1 candles	79·8 ,,
50	8·4 ,,	78·0 ,,
58	18·0 ,,	75·0 ,,

These results are also expressed in the curve shown in Fig. 1.

The fact of a decrease of resistance with rise in temperature with carbon was previously noticed by Matthiessen in 1858 (see "Phil. Mag.," vol. xvi., pp. 220—221). This experimenter found the electric conductivity of ordinary gas-coke to rise about 12 per cent. between the common temperature and a light red heat.

In the case of this delicate thread of impure carbon constituting the loop of the lamp, the rate of increase in conductivity or fall in resistance is more rapid. Fig. 1 shows the above observations plotted as a curve, and needs no further explanation.



In the above discussion we have compared the resistance of

* Communicated by the Authors to the *Philosophical Magazine* for July.

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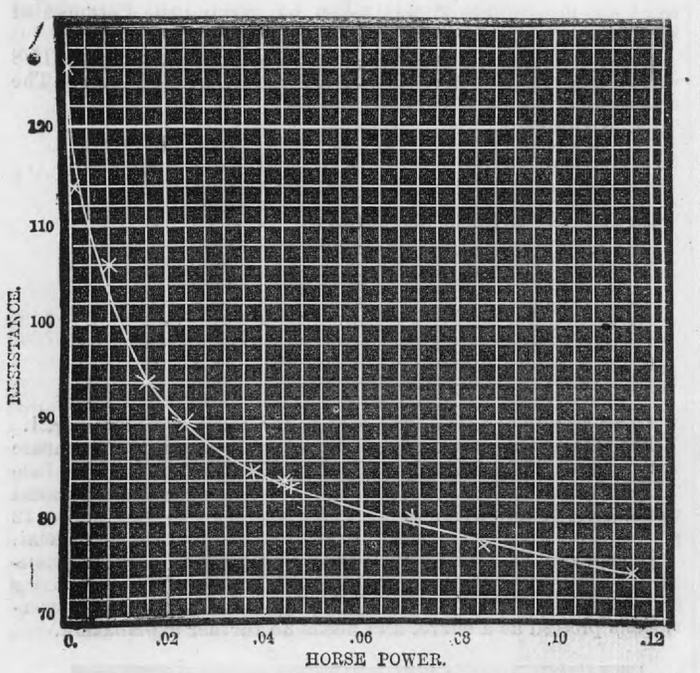
the lamps with the luminous emissions only; but we have once considered it worth while to make an analogous but more extended comparison, namely, one between the resistance and the total heat, or total heat and light, generated in the lamp. This enables us to carry the range of comparison below those points at which sensible light is developed. As a matter of course, this relation to total heat is also the relation to energy transformed; and this also we have given in the following table, expressed in foot-pounds and in horse-power.

These results are also expressed in the curve (Fig. 2); and it is interesting to notice the general similarity of this curve to that of Fig. 1.



It might at first seem desirable to establish a temperature-ratio in the same connection; but when we reflect that this would depend on a number of conditions liable to variation with individual lamps, and would really have no practical bearing on the question of power consumed and light produced, it will be seen that this line of investigation hardly promised enough to warrant us in pursuing it. For example, if the carbon loop were surrounded by a less perfect vacuum, or by one or another gas such as nitrogen or hydrogen, there might be great differences in temperature even with the same resistance and current, or total heat.

Energy transformed into heat, and into heat and light in loop of lamp.			Resistance in ohms.	Candle-power.
As foot-pounds.	As horse-power.	As total heat-units.		
66	·002	·0855	114	0
83	·0025	·1039	112	Just visible.
122	·004	·1710	111	Dull red.
244	·008	·342	106	Cherry-red.
488	·016	·684	94	·016
792	·024	1·026	90	·10
1254	·038	1·624	84·4	·59
1452	·044	1·881	84	·83
1518	·046	1·966	83·3	1·10
1650	·050	2·137	82·5	1·5
2343	·071	3·035	80	4·5
2838	·086	3·676	77·6	9·2
3828	·116	4·958	74·5	20·0

II. *Determination of the average light of the lamp in all azimuths.*—It was noticed at once that there was a vast difference between the amount of light given out by the lamp in a direction transverse to the plane of the loop and in the direction of that plane, the former quantity being about three times as great as the latter; and while it would of course be possible, on certain assumptions, to estimate what should be the average it was also perceived that a direct determination by experiment would be far more reliable and important than any amount of theoretical discussion.

The lamp was, therefore, mounted on a divided circle with the axis of the lamp passing through its centre. A fixed index measured the angle of rotation of the circle and lamp, and was so placed as to read 0° when the plane of the loop was in the axis of the photometer. This was indicated by a well-defined line of shadow of the nearer half thrown by the further half of the loop on the photometer-disc.

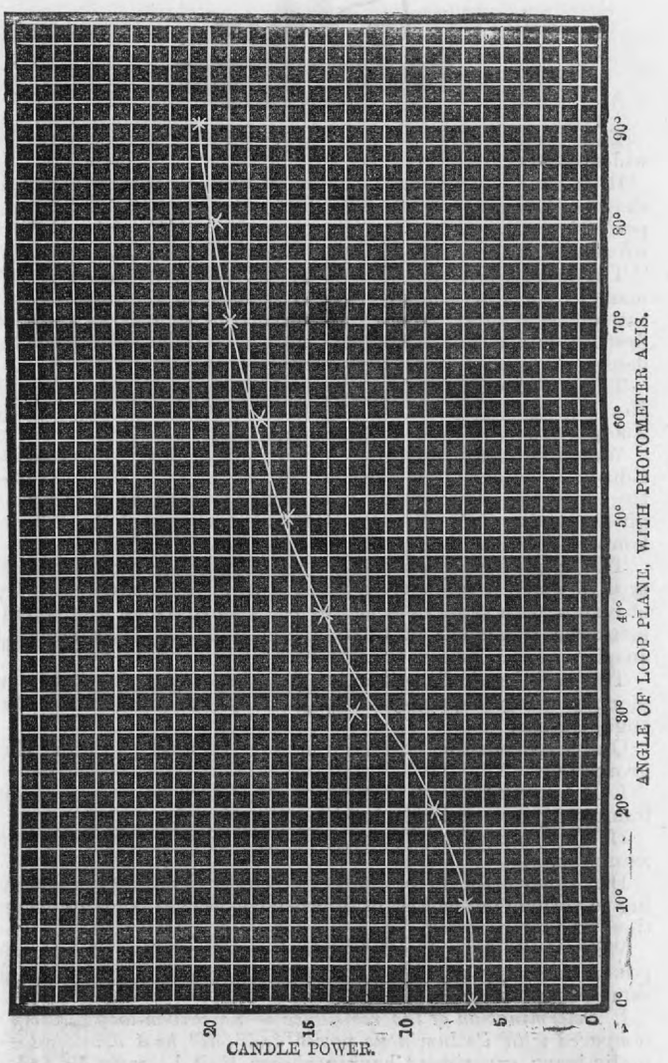
The lamp was rotated 10° at a time; and several readings were made in each position, the averages of which are given in the accompanying table.

Candle-power of loop in various azimuths.

Angle of plane of loop to axis of photometer.	Candle-power.
°0	6·7
10	6·9
20	8·4
30	12·8
40	14·3
50	16·3
60	17·7
70	19·1
80	19·8
90	20·6
10)142·6	

Average = 14·26 = 69 per cent. of maximum.

This shows the results for one quadrant. Similar experiments were made for the three other quadrants, with like results. Fig. 3 exhibits the results of the table plotted in a curve.



III. *Determination of current-strength in circuit corresponding to various intensities of luminous power in lamp and of deflections of galvanometer.*—For these determinations the apparatus was arranged as follows:—The battery-current was passed through one coil of a Gaugain galvanometer, then through a copper voltameter, and then through the lamp placed in the photometer, thence returning to battery.

The amount of copper deposited in a known time gave, of course,

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the current-strength, in view of the fact that a current of one weber deposits ·326 milligramme of copper in a second.

Thus, in the first experiment, 1062·4 milligrammes were deposited in an hour, or in 3,600 seconds; therefore

$$\frac{1062{\cdot}4}{{\cdot}326 \times 3600} = {\cdot}905 \text{ weber current.}$$

Three experiments were made of this sort, the data and results of which are given in the following table:—

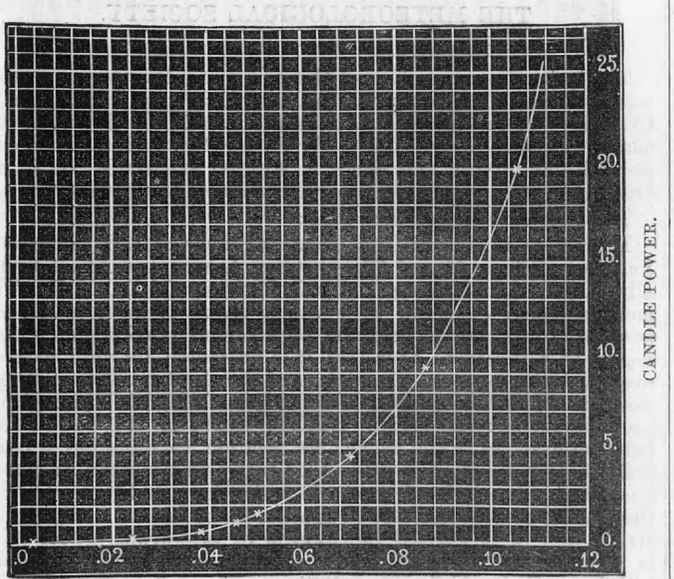
Weights of cathode.			Time.	Current, in webers.	Maximum candle-power.
Before.	After.	Gain.			
43398·4	44460·8	1062·4	60 min.	·905	15
48314·0	49110·0	796·0	40 ,,	1·017	17·6
43105·0	43617·0	512·0	25 ,,	1·047	19·8

From the current in webers and the corresponding resistance in ohms, where these had been determined as above, it was of course easy to deduce the exact amount of energy transformed into light and heat, and to compare the same with the actual candle-power afforded by the lamp at the same time.*

To make the results more general, however, the constant for the tangent-galvanometer used in all the experiments was determined, so that the current-strength corresponding to its readings could be obtained in the cases where the voltameter had not been employed. This constant was found to be ·262, so that the tangent of the galvanometer-reading multiplied by ·262 gave the current-strengths in all cases.

IV.—*Determination of power consumed by lamp only in maintaining light of different intensities.*

No. of cells of battery.	Deflection of galvanometer.	Current, in webers per second.	Resistance of lamp.	Horse-power.	Candle-power.	
					Maximum.	Average.
8	23·0	·111	114·0	·002	0	
9	26·2	·129	112·0	·0025	Just visible.	
10	32·0	·164	111·0	·004	Dull red.	
15	42·4	·239	106·0	·008	Cherry-red.	
20	54·0	·361	94·0	·016	·016	
25	59·5	·445	90·0	·024	·10	·07
30	65·6	·578	84·4	·038	·59	·41
33	67·3	·626	84·0	·044	·83	·58
34	67·9	·645	83·3	·046	1·10	·77
35	68·7	·672	82·5	·050	1·5	1·05
40	72·1	·811	80·0	·071	4·5	3·1
45	73·9	·908	77·6	·086	9·2	6·4
50	76·3	1·079	74·5	·116	20·0	14.0



HORSE POWER.

As regards the economic relations of this subject, it will be interesting to notice that, an average light of 14 candles being obtained at the expense of 0·116 of a horse-power in electric current, each horse-power of electric energy would furnish 120 candle-power in these lamps. To obtain this horse-power of electric energy, however, considerably more mechanical energy must be applied to the driving-pulley of the electric generator. If the loss so encountered was 40 per cent., as appears to be the case with some of the best machines which have been measured accurately, this would reduce the light developed to 72 candle-power for each horse-power of mechanical energy applied to the driving-pulley of the electric generator.

When we remember that with the arc-light there has been obtained from 1,200 to 1,800 candle-power per horse-power of mechanical energy applied to the generator, it is evident that Mr. Edison's lamp as now made does not escape the enormous loss which has heretofore been encountered by all forms of incandescent electric lamps.

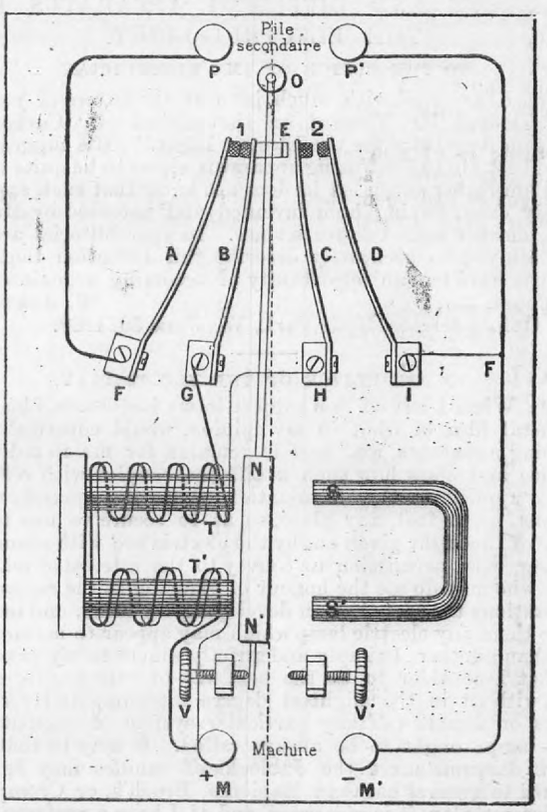
* Thus, for example, in one experiment the average candle-power being 10+ candles, the resistance of the lamp was 76 ohms and the current 905 weber.

AUTOMATIC CONNECTOR AND DISCONNECTOR FOR CHARGING SECONDARY BATTERIES.

(Translated from *La Lumière Electrique*.)

When a secondary battery is charged by means of a magneto-electric machine, and from any cause the engine which drives the latter comes to a stand-still, or moves with a velocity diminished beyond a certain point, the electromotive force of the source becomes less than that of the secondary battery, and a current from this battery will then pass through the magneto-machine, aiding its movement, but otherwise expending in pure loss the energy which had previously been stored up. If the secondary battery be charged from a primary battery, the polarisation of the latter conduces to the same result, and the electricity accumulated may be uselessly expended.

In order to overcome this difficulty, M. Hospitalier has devised an automatic apparatus, the effect of which is to open the circuit of the secondary battery so soon as the electromotive force of the source becomes insufficient to continue the charging operation, and again to replace the secondary battery in the circuit when the source has regained its power.



The apparatus represented in the cut is composed of an electro-magnet T T_1, upon which are wound two wires, one very short and thick, making only a few turns upon the bobbins; the other very fine and long, coiled over the thick wire. An armature N N_1, of soft iron, moves in front of the poles of the electro-magnet, and oscillates about its point of suspension O; the amplitude of the movement being regulated by means of the screws V V_1. A permanent magnet S S_1, facing the electro-magnet, acts upon the armature like a retaining spring, with the essential difference,

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however, that its maximum effect is exerted when the armature is in its position of greatest proximity to this magnet. The magneto-machine or other electrical source is connected to the terminal screws M M_1; and the secondary battery to the screws P P_1. The wires attached to these screws respectively are led into contact with four springs A B C D, by means of which two electrical contacts are produced at 1 and 2. The following is the mode in which the apparatus acts.

Let us suppose in the first place that the current is sufficiently powerful to effect the charge of the secondary battery; in this case the armature is in the position shown in the diagram. The current from the source passes by M through the thick wire of the electro-magnet, then by G B through the contact established at 1 by the pressure of the non-conductor E attached to the rod O N, then through the spring A and the wire F P to the secondary battery connected between P P_1, returning to the source through P_1 M_1.

It will be seen that, the contact at 2 being broken, no current traverses the fine wire coiled upon the electro-magnet.

Let us suppose that the electromotive force of the source gradually diminishes; at some period there will be equilibrium between the electromotive force of the source and that of the secondary battery. When this happens, the electro-magnet, being no longer traversed by any current, will release its armature, which, under the influence of gravity and of the attraction of the permanent magnet, will break the contact at 1 and establish that at 2; when the source will transmit a current through the *fine wire* wound on the electro-magnet.

Lastly, if the apparatus be properly adjusted, the armature will be attracted by the electro-magnet T T_1, when the current becomes sufficiently powerful to effect the charge of the secondary battery; the contact at 1 being then re-established.

By circuiting the apparatus of M. Hospitalier between an electrical source and a secondary battery, the discharge of the latter by the effect of the cessation or the weakening of the charging current may be effectually prevented. The apparatus may be employed for the purpose of utilising natural and variable sources of power; such as the wind, the flow of streams, and the rise and fall of the tide, for the purpose of storing up energy in secondary batteries.

CARBONS AND DIFFUSING APPARATUS FOR THE ELECTRIC LIGHT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I have read with much interest the letters of your able correspondent Mr. Vassard on the subject of "Carbons and Diffusion Apparatus for the Electric Light." His suggestion as to the best kind of diffusing apparatus seems to be quite correct, but I am rather surprised he does not know that such apparatus already exist, having been invented and patented by Mr. J. L. Pulvermacher some two years since. In your editorial article of June 5th you so accurately describe this invention that I feel sure you have had an opportunity of becoming acquainted with it.—Yours, &c., W. JOHNSON.

24, Oxford-terrace, Hyde Park, W., June 30, 1880.

TO THE EDITOR OF THE ELECTRICIAN.

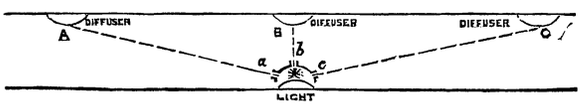
SIR: When I left off this subject in my last letter, I had given a general idea of what, in my opinion, would constitute a real diffusing apparatus, and now it remains for me to redeem my promise and show how such a diffuser, coupled with reflection, can be applied to the illumination of streets, squares, railway stations, or, in fact, any place, so as to secure to use the full power of the light given out by the electric arc with economy.

I beg, here, permission to convey to the interested readers of yours who may do me the honour of glancing at the *exposé* of my lucubrations the fact that, in developing my ideas, and in adapting to them any electric lamp which may appear to me more suitable than another, I simply and strictly adhere to my own theory of what I consider to be the best way of utilising the electric light, without in the slightest degree intending to refer to the merits or demerits of any particular system of regulators, as these lamps ought to be always called. It may be that under certain circumstances the Jablochkoff candles may be better adapted to general use than Rapieff's, Brush's, or Crompton's; but for my plan it is *vice versâ*, and if I have a preference it is for Hendrich's.

What I pretend to do is to show that, given a steady source of electric light, it can be divided by reflection so as to secure full utilisation of the illuminating power of the electric arc, and in so doing I am merely carrying out the idea I gave expression to more than two years ago through the medium of one of your evening contemporaries, namely, the *Globe*, when I said that so long as the extra amount of light given out at one point could not be diverted and made use of at another spot, the gas shareholders had no need to fear depreciation of their property.

Every system of lighting requires special arrangements. It would have been absurd for anyone to expect that the old appliances, which were doing well with candles or oil, could be retained when gas made its appearance first, or that even what I should call the science of lighting engineering could be the same for both. For the same reasons it is impossible to expect that the electric light can be distributed to advantage under circumstances suited to gas.

In the first instance I should, in lighting streets by electricity, put my lamps (and by lamp I take the literal meaning of the word) against the walls of the bordering houses. No doubt many objections would be raised against such a proposal were it to be carried out in practice in its crude form. An old fashioned landlord, an unfavourable tenant, or it might be a gas shareholder (the latter the more formidable opponent of the three), might very likely be found to object to the idea; but so long as my project is on paper only I need not take much notice of such probable objection, and I do then, regardless of opposition, put my focus of light against the wall of a house, wherefrom I divert the rays in three different directions in the case of a straight street (a very uncommon thing in London, by the way), two at angles more or less obtuse according to the width of the street, and the other right across it as follows:—



The focus or source of light is screened by a kind of reflector provided with three holes, a b c, through which the luminous rays from the arc pass, and go to strike on the reflecting diffusers A B C. A spectator looking from the centre, or thereabout, of any one of these reflectors would be the only one capable of seeing the naked source of light, and not even would the screen create any shadow, as its outside would be reflecting the light from C.

With such a plan, four or more foci of light would be secured with only one fed direct from the dynamo-electric machine, and, moreover, the light being perfectly diffused, and I might say reverberated, the street would be entirely and equally illuminated.

No doubt many other ways of realising the same effect may be guessed or devised, and as the diffusing reflectors I am here advocating would take the form adapted to the peculiarities of the case instead of being made of an uniform shape, there can be no doubt that any place, of whatever configuration, could be lighted by electricity at a great deal less cost than is the case at present. A few examples in my next will demonstrate it.—Yours &c.,

16, Annandale-road, East Greenwich, A. VASSARD.
30th June, 1880.

THE METEOROLOGICAL SOCIETY.

The last ordinary meeting of this society for the present session was held on Wednesday, the 16th inst., at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., President, in the chair. T. W. Barry, M.D.; A. W. Martin, and C. E. Peck, were elected fellows, and Senor A. Aguilar and Dr. H. H. Hildebrandsson were elected honorary members of the society.

The following papers were read:—

1. "Ozone in Nature: Its Relations, Sources, and Influences, &c., from Fifteen Years' Observations Ashore and Afloat under all Conditions of Climate." By J. Mulvany, M.D., R.N. The meteorological elements with which ozone is most intimately associated are such as occasion high vapour tension and a high degree of saturation; therefore it is promoted by wind passing over a large aqueous expanse, and by heat-producing rapid evaporation. Hence, heat, if humid, is no bar to atmospheric ozonisation, but no definite relation exists in the atmosphere between heat *per se* and ozone; its relation to humidity is more definite and direct, but subject to many exceptions; in consequence of this relation it most abounds where its chemical qualities render it most useful. It appears to be formed in the upper strata, and to be carried downwards by rain-drops, whose office is vehicular. The spherules of water which constitute clouds, and have their origin in radiation and condensation, have a similar office. Ozone does not appear to diffuse readily downwards, so that when the lower strata are robbed of ozone by jungle, &c., a considerable difference in the ozonic condition close to and at 170 feet above the surface may exist. The author is of opinion that no disease can be clearly traced to ozone as met with in the atmosphere.

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2. "The Average Height of the Barometer in London." By Henry Storks Eaton, M.A., F.M.S.

3. "Note on a Waterspout observed at Morant Cays, Jamaica, March 23rd, 1880." By Lieut. Alfred Carpenter, R.N., F.M.S.

4. "Account of a Balloon Ascent, from Lewes, in a Whirlwind, on March 23rd, 1880." By Captains James Templer and H. Elsdale.

5. "Results of Meterological Observations made at Stanley, Falkland Islands, 1875-77." By William Marriott, F.M.S.

6. "A New Thermograph." By William David Bowkett.

7. "The Winter Climate of Davos." By C. T. Williams, M.D., F.M.S.

Among the high altitude sanitaria of Europe, Davos at present enjoys the greatest reputation, partly on account of its easy accessibility, and partly on account of certain peculiarities of position and shelter. The valley of Davos lies in the Canton of the Grisons, between the valleys of the Lower Rhine and the Upper Engadine. The valley runs from N.N.W. to S.S.E., for about 10 miles in length, with an average breadth of about a third of a mile, being for the most part of this extent a plain gently sloping towards the north, and varying in elevation from 5,400 to 4,500 feet. Davos Platz is 5,105 feet above the sea level. The author discusses the observations made during the four winters of 1876-7 to 1879-80. The peculiar effects of Davos winter climate seem to depend on—1. The rarefaction of the atmosphere; 2. Its dryness; 3. The absence of strong currents, owing partly to shelter, and partly to the uniform layer of snow spread around; and 4. The large percentage of the *direct* solar rays reaching the locality owing to rarefaction of the air, and also the considerable amount of heat reflected from the extensive snow plain in front of the villages of Davos Platz.

A NEW VOLTAIC BATTERY.

The ingenious French mechanician, M. Regnier, well-known for his electric incandescent carbon lamp, in which a small pencil of carbon rests on the edge of a carbon disc, has brought out another novelty in the form of a powerful, and, according to accounts, a constant voltaic cell, which has likewise the advantage of yielding residues capable of being regenerated by electrolysis.

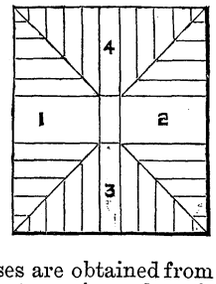
The battery is a hydro-electric one, and in strength is comparable to that of Bunsen, without the attendant objections of the latter.

The zinc plate is immersed in a solution of caustic soda, the negative plate, which is of copper, being depolarised by a solution of sulphate of copper separated from the alkaline liquor by a porous partition. The couple thus constituted is said be very constant; and its electromotive force is high, from 1·3 to 1·5 volts, according to the strength of the solutions.

As the solutions of sulphate of copper and caustic soda in their pure state have only a medium conductivity, M. Regnier diminishes their resistance by adding certain other salts not stated. He also notably reduces the resistance of the porous plate by fashioning it of parchment paper, as already employed by Sir William Thomson, M. Carré, and others. Several sheets of this paper are placed side by side to moderate the permeability of the substance, and made up into the rectangular shape shown in Fig. 1.

FIG. 1

FIG. 2



These prismatic vases are obtained from flat sheets, having the edges raised according to a given plan of folding, shown in Fig. 2. The cross folds are shown by the stronger, and the salient folds by the weaker lines in this diagram.

With this battery the initial electromotive force, after charging, is 1·47 volts, descending to 1·35 volts after a long short circuit. The resistance is 0·075 ohms for a cell 0·20 metres high, and three litres in capacity.

To compare the behaviour of the new cell with others in use, M. Regnier gives the following table of results, in which E is the electromotive force, R the internal resistance, T the maximum external work in kilogrammètres per second, as calculated by the formula :—

$$T = \frac{E^2}{4R \times 9{\cdot}81}.$$

By dividing the values in kilogrammètres by the mechanical equivalent of heat we get the values of the work in calories (gramme-degree) given in the last column of the table.

Kind of Battery.	Constants. E Volts.	Constants. R Ohms.	Work. T Kilogram-mètres.	Work. T In Calories.
Bunsen, ordinary round model, height 0·20 mètre	1·80	0·24	0·344	0·796
Ditto Ruhmkorff's rectangular model, height 0·20 mètres	1·80	0·06	1·378	3·189
Daniell, round model, height 0·20 mètre	1·06	2·80	0·010	0·023
Thomson's Tray Battery	1·06	0·20	0·143	0·331
Carré's Cylindrical Battery, height 0·60 mètre	1·06	0·12	0·238	0·551
Regnier's Battery, rectangular model, height 0·20 mètre	1·35	0·075	0·619	1,440

The results indicate that the new battery of 0·20 mètres size surpasses larger zinc-copper batteries in energy. It would seem to be about twice stronger than the ordinary round Bunsen of the laboratories, and is only surpassed by the rectangular Bunsen of Ruhmkorff's design.

The zinc is not amalgamated, nevertheless it is not attacked when on open circuit by the liquid surrounding it. The consequence is that the weight of zinc consumed is in accord with the theoretic quantity corresponding to the electricity generated.

The battery emits no volatile products, and therefore there is no loss of material, though it is transformed into other combinations. These products can be regenerated or brought back to their original state. The zinc and copper can be recovered from the waste liquor by electrolysis. For this purpose the current from a magneto-electric machine may be employed. By passing the machine current through the battery as it stands, M. Regnier thinks the latter could be made a convenient store for electricity; but we do not exactly see how this could be practically carried out. M. Regnier has yet to demonstrate this point. As for the cell itself it appears to be a very useful sort, but is not, we think peculiarly new. Alkaline solutions have been employed before round the zinc instead of acid ones, by the elder M. Becquerel. We are not, however, aware if the combination of alkali and sulphate of copper has ever been made before.

NEW CABLES FOR DENMARK.

Our readers will remember that during last summer a new cable was laid between Germany and Norway in order to divert, if possible, some of the Scandinavian traffic and Continental traffic past the Danish lines. It was thought at the time that Prince Bismarck was at the bottom of this manœuvre, and public opinion ran high over it in Denmark. Our enterprising neighbours do not seem to have suffered materially from the blow, if blow it were, indeed, it has rather stimulated them to fresh exertions, for we learn privately from Denmark that fresh ventures are to be embarked upon.

We are informed on good authority that on June 18 the Swedish Government ratified an agreement concluded between the Great Northern Telegraph Company of Copenhagen on the one hand, and the Swedish Telegraph Administration on the other. By the terms of this agreement the Great Northern Telegraph Company are bound to double the direct telegraphic connection between England and Sweden. To carry this project out, the agreement specifies that the new means of communication will consist of a cable between the English coast, at a point near Newcastle, and the Norwegian coast, at a point near Arendal (where the German-Norwegian cable was landed). From Arendal another cable will be laid to the Swedish coast, at a point near Gothenburg. The telegraph office of Gothenburg is to be connected to the cable by means of an aërial line.

The Great Northern Company have engaged to finish the whole work before the end of November next; but if any unforeseen

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difficulties arise to prevent this, they will be allowed an extension of time till the end of the year 1881.

The Swedish Government have, in addition to this arrangement, granted to the Great Northern Company a prolongation of the earlier privileges of the company to construct telegraph lines in Sweden for thirty years, dating from 1881.

From these proposals it will, we think, be seen that the Great Northern Company is pursuing its advantages in Northern Europe.

A NEW FORM OF GALVANOMETER.

A new form of galvanometer, specially designed for measuring thermo-electric currents, has been presented to the French Academy by M. L. Gostynski. It is particularly distinguished from other galvanometers by its two astatic needle systems of the same polarity, and its principal advantage over these consists in the fact that it gives readings proportional to the current up to a deflection of nearly 90°, and thus dispenses with the use of tables of corrections for accurate tests.

Having had to make or verify a great number of determinations of the transmission of heat across layers of water of various thicknesses, M. Gostynski was led to devise a means of measuring the heat at once simple, precise, and convenient. The thermo-electric apparatus he constructed was found to unite these conditions, and at the same time proved exceedingly sensitive.

It consists of a continuous or entire bobbin of wire, that is to say, a coil in which no aperture is left for the passage of the usual astatic system, and a frame of aluminum in the form of the letter U, suspended by a floss silk fibre. This frame supports two similar astatic systems, crossed at an angle of about 45°, and connected to each other. In a small mirror vertically surmounting the frame, and carried by the double astatic system in its rotatory movement under the action of the current, the divisions of a semi-cylindrical scale are reflected. The zero position of the scale corresponds to the position of the frame, at which one of the two astatic systems is parallel to the turns or spires of the bobbin, the direction of the current being such that the other system directs itself towards the starting point of the first.

M. Gostynski has tested the proportionality of the deflections to right and left of zero for various strengths of current, and more than 150 series of observations, each series comprising at least six determinations, have assured him of the correctness of the indications. The apparatus was constructed by M. Carpentier, of Paris.

THE EASTERN TELEGRAPH COMPANY (LIMITED).

Report of the Directors to be presented to the sixteenth ordinary general meeting, July 15th, 1880:—

The Directors submit the accounts and balance sheet for the six months ended 31st March, 1880. The Company's revenue for this period amounted to £291,194 16s. 2d., from which is deducted £68,637 18s. 8d. for the ordinary expenses of the Company, and £19,896 11s. 9d. special expenditure during the half-year, and £1,999 10s. 2d. for income tax, leaving £200,660 15s. 7d., which, together with £15,279 8s. 7d. brought forward from the preceding half-year, gives a balance of £215,940 4s. 2d. From this balance, £22,347 12s. 4d. has been paid for interest on debentures, and £20,561 18s. for dividend to 31st March, 1880, on the preference shares. The directors have during the half-year paid an interim quarterly dividend of 1½ per cent. on the ordinary shares. They now recommend the declaration of a final dividend for the year ended 31st March, 1880, of 2s. 6d. per share, payable on the 16th instant, making, with the three previous payments on account, a total dividend for the year of 5 per cent. on the ordinary shares, and that the balance, £78,205 13s. 10d. be carried to the reserve fund, which will then amount to £262,849 3s. 3d. The steamship Chiltern is engaged in restoring communication by the duplicate cable from Vigo to Lisbon. With the exception of this section the Company's cables are all in good working order. The other repairing ships are stationed in the Red Sea and Mediterranean, fully equipped in readiness for the Company's requirements. The Directors have from time to time received applications for assistance to the relatives of deceased members of the staff, and for the relief of those becoming incapacitated through illness from performing their duties. With the view of meeting such cases for the future, and encouraging the *employés* of the Company to make provision for the risks to which many of them are especially exposed in the climates where they are necessarily stationed, the Board has, subject to the approval of the shareholders, made arrangements by which the Company's officers can secure the payment to themselves of a limited sum at a fixed age, or to their relatives in case of death, the Company paying half the premiums required. It is estimated that if this plan is availed of by the *employés* generally, the cost to the Company will be about £2,500 per annum. A resolution authorising the Directors to carry out this arrangement will be submitted to the meeting. Since the last general meeting the Directors have issued 9,600 ordinary shares, and with the proceeds purchased for the Company 9,500 fully paid shares of the Eastern and South African Telegraph Company. They have also provisionally taken, for £95,000 cash, a further 9,500 of those shares, with the dividend accrued thereon since that Company's line was opened and established. The returns from the line during the past six months have been sufficient to pay a dividend for that period, at the rate of 6 per cent. per annum on the entire share capital, after discharging all working expenses, interest and amortization of debentures, and making a substantial reserve for repairs and renewals. The Directors are of opinion that the acquisition of the above shares—which, with those already held, will give to this Company £390,000 out of the total share capital of £400,000—is a decided advantage to the shareholders. The meeting will be asked to sanction the payment of the £95,000 for the purpose mentioned. It is proposed for the present to provide the amount required partly out of the current balances, partly by loans for short periods, and the remainder by the temporary application for that purpose of a portion of the reserve fund; the intention of the Board being to replace all such advances when the renewal or re-arrangement of the debenture debt of the Company is effected.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 7.		Business Done Week Ending July 7. Highest.		Lowest.	
Anglo-American Ordinary	61½,	62	.....	62¾	.....	61¼
Do. "B"	92¾,	93¼	.....	93⅝	.....	92⅝
Do. "A"	33½,	34	.....	35⅛	.....	33⅞
Brazilian	8⅝,	8⅞	.....	8¾	.....	8⅝
Cuba	9½,	10	.....	9⅝	.....	9⅝
Do. Ten per Cent. Pref.	15½,	16½	.....	—	.....	—
Direct Spanish	1¾,	2¼	.....	—	.....	—
Do. Ten per Cent. Preference	11,	11½	.....	—	.....	—
Direct United States	11¼,	11½	.....	11⅝	.....	11¼
Eastern	9⅜,	¼	.....	9⅝	.....	9 1-16
Do. Six per Cent. Debenture	103,	106	.....	—	.....	—
Do. Five per Cent. do. 1899	104,	107	.....	—	.....	—
Do. Six p Ct. Preference	12⅛,	⅜	.....	—	.....	—
Eastern Extension	9¼,	9⅜	.....	9⅜	.....	9¼
Do. Six per Cent. Deb.	107,	110	.....	—	.....	—
German Union	8¾,	9¼	.....	—	.....	—
Globe Telegraph & Trust	6 1-16,	6 3-16	.....	6¼	.....	6⅛
Do. Six p Ct. Preference	12 1-16,	12 3-16	.....	12⅜	.....	12⅛
Great Northern	9½,	¾	.....	9¾	.....	9⅝
Indo-European	23,	24	.....	23½	.....	23
Mediterranean Extension	2¾,	3¼	.....	—	.....	—
Do. Eight per Cent. Preference	10½,	11	.....	—	.....	—
Reuter's	9½,	10½	.....	10⅛	.....	9½
Submarine	237,	242	.....	—	.....	—
West India and Panama	1⅛,	⅜	.....	1 7-16	.....	1¼
Do. Six per Cent. 1st Preference	7⅛,	¾	.....	7⅜	.....	7⅛
Western and Brazilian	6¾,	7	.....	7 1-16	.....	6⅞
West. Union 7 p. Ct. 1st Mt.	120,	125	.....	—	.....	—
Do. Six per Ct. Sterg.	104,	107	.....	—	.....	—

TRAFFIC RECEIPTS FOR JUNE, 1880.

Companies.	June, 1880.	June, 1879.	Increase.	Decrse.
Cuba Submarine Company	2,700 estd.	2,425	275	—
Direct Spanish Telegraph Company	1,277 estd.	1,025	252	—
Eastern Extension Telegraph Company	29,100	26,485	2,615	—

BRITISH ASSOCIATION for the ADVANCEMENT of SCIENCE, 22, Albemarle-street, London, W.

The NEXT ANNUAL GENERAL MEETING will be held at SWANSEA, commencing on WEDNESDAY, August 25.

President Elect,
ANDREW CROMBIE RAMSAY, Esq., LL.D. F.R.S. V.P.G.S.,
Director-General of the Geological Survey of the United Kingdom and of the Museum of Practical Geology.

NOTICE to CONTRIBUTORS of MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organizing Committees for the several Sections *before the beginning of the Meeting*. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several Communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and the Council request that he will send it, together with the original Memoir, by book-post, on or before July 24, addressed thus:—"General Secretaries, British Association, 22, Albemarle-street, London, W. For Section....." Authors who comply with this request, and whose Papers are accepted, will be furnished *before* the Meeting with printed copies of their Reports or Abstracts. If it should be inconvenient to the Author that his Paper should be read on any particular days, he is requested to send information thereof to the SECRETARIES in a separate note.

Reports on the Progress of Science, and of Researches entrusted to individuals or Committees, must be forwarded to the ASSISTANT-SECRETARY, for presentation to the Organizing Committees, accompanied by a statement whether the Author will be present at the Annual Meeting.

No Report, Paper, or Abstract can be inserted in the report of the Association unless it is in the Assistant-Secretary's hands before the conclusion of the Meeting.

J. E. H. GORDON, Assistant-Secretary.

ASSISTANT ENGINEER WANTED for the Scottish Telephonic Exchange (Limited), 34, St. Andrew-square, Edinburgh. A young civil or mechanical engineer with good knowledge of electricity preferred.

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SLIP

THE PARIS FETE.—The municipality of the city (says the *Standard*) during the *fête* had an electric light in one of the windows of the Paris office of that paper.

NORWAY.—The submarine line of telegraph between Hamburgh and Arundal, completed last year, cost the Norwegian Government 46,000 kroner, equal to about £2,550.

JAVA.—The Blue Book—being part IV. of the Consular Reports—notices the new cable lately laid by the Eastern Extension Company, and states that "it is expected to be of great service."

LITERATURE.—"An article from the pen of Mr. J. Laister of the General Post Office, entitled the "Whitewashing of Shylock," appears in the July number of *Modern Thought*."—*The Civilian.*

THE PRESIDENCY OF THE UNITED STATES.—The New York *Graphic* suggested Dr. Norvin Green as a suitable candidate for the high post of President. The hint, however, was not taken.

MONTREAL.—Experiments have been made with the electric light for the purpose of ascertaining how far it would permit of continuous work in the harbour. It was found that, practically, loading and unloading vessels could be carried on by its aid as well by night as by day.

SIEMENS'S ELECTRIC RAILWAY.—As the next meeting of the Iron and Steel Institute will, at the end of August, be held at Dusseldorf, many readers will have an opportunity of seeing this railway, which has been laid in that portion of the Exhibition Grounds, near Krupp's Pavilion.

PERSIA.—During the year 1879 a submarine cable was laid down between Bakou and Krasnavodsk, and a field line of telegraph now connects Chekishlar with Asterabad; the latter has been handed over, with all its apparatus, to the Persian Government, but continues to be worked by a staff of Russian telegraphists until Chekishlar be connected by telegraph with Krasnavodsk.

JOURNAL OF THE CHEMICAL SOCIETY.—The current number of this excellent journal contains abstracts of the following electrical papers, some of which we give elsewhere:—i. "Use of Smithson's Pile for the Detection of Mercury in Mineral Waters;" ii. "Electrolysis of Terebenthene;" iii. "Electrolysis of Malonic Acid;" iv. "Thermo-electric Properties of Liquids."

ANIMAL ELECTRICITY.—*La Nature* gives the first portion of an illustrated article "On the Electrical Function of the Torpedo," in which the experimental researches of M. Marey in this direction are referred to at considerable length. M. Maray has arrived at the conclusion that "the electricity in the apparatus of the torpedo and muscular work are produced under similar physiological conditions."

STRIKE OF TELEGRAPH BOYS.—It is stated that the telegraph boys of Newcastle-on-Tyne object to a reduction of the payment per message delivered, and, in consequence, to the number of more than eighty, have struck work. We think the boys have been ill-advised, and that it would have been better to have had the case considered carefully by the central authorities before taking such a rash step.

NEW USE FOR THE TELEPHONE.—To avoid the inconvenience of having to cut and splice a telegraph cable unnecessarily, as when several lie close together and one only is faulty, it is now suggested to employ the telephone on an auxiliary parallel wire, in which the induction may be sufficiently strong to enable the electricians in charge to read the signals which may be sent into the cable, and so identify it.

HOLYOKE, MASS., U.S.A.—H. C. Spaulding, of Boston, and Oliver Warner are arranging for a wholesale experiment in lighting Holyoke, Mass., with electricity. The apparatus will be run with power from the new wheel-pit which the water-power company are going to put in for their mills. A tower will be built 200 feet high in some central locality, and the experiment will be to see how much of the city can be lighted.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—The Board has resolved to recommend a final dividend of five shillings per share, such dividend to be payable on and after the 16th August next, making with the interim dividends already paid, five per cent. for the year ending 30th June last, carrying forward £21,760 8s. 10d., after having carried to the reserve fund £22,847 14s. 3d., making it up to £175,000.

PROMOTIONS.—We learn from the *Gazette of India* (June 12) that the appointment of Mr. MANCE as engineer and electrician to the Persian Gulf Telegraph is confirmed; that Mr. G. SEALY, late assistant superintendent Persian Gulf Telegraph, is promoted to superintendent; that Mr. R. C. LAUGHLIN, assistant superintendent 1st grade Indian Telegraph Department, is appointed to officiate as superintendent 3rd grade from May 18.

OVERHEAD WIRES.—At the last meeting of the Islington Vestry Mr. Barton complained of a very long and unsupported telegraph wire in Roman-road. It might snap and cause an accident similar to that which happened in Duncan-street some years ago. He wanted to know if the Vestry had any control over such things.—The Vestry Clerk said they had no power to interfere. Telegraphs were under the control of the Postmaster-General.

STOPPING ENGINES.—An improved method of stopping engines has been devised by Mr. James Tate. The main object of the device is to enable any child or unskilled person in any part of a mill to stop the engine in case of an accident. The action is exceedingly simple. By touching a spring similar to the spring of an electric bell, an electric ball is set in motion, and the ball drops and shuts one of the valves, which prevents the steam from escaping, and the engine is brought to a standstill.

IMPROVEMENT IN THE EDISON LAMP.—A Mr. J. H. Guest, of Brooklyn, has been attempting to make the "Edison lamp" perfect. He thought the principal trouble would be the entrance of air around the wires at the point of fusion in the glass, and to remedy this encloses the joints in small globes formed on the ends of the glass where the wires pass through into the vacuum globe. These globes are partially filled with mercury in order to ensure an air-tight joint. We see no reason why the cheaper material, water, should not be used instead of mercury, but we may also point out that this does not prevent the disintegration of the carbon, which is *the* weak point in the lamp.

THE LIVADIA.—In connection with the magnificent vessel which is being built by Messrs. Elder and Co. for the Emperor of Russia as a pleasure yacht—a floating palace—the electric light has been used on an extensive scale so that she might be ready for launching in time. No fewer than six lamps are in use on the vessel itself, and a similar number gave forth their brilliant light in the works where the immense engines for the yacht were erected. Even after the launching of the vessel the electric light is employed for the benefit of the night shift; and, eventually, the floating palace is to be

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fitted up with about 60 electric lamps, supplied with the necessary currents from a Siemens magneto-electric machine of the requisite power.

TELEGRAPH APPARATUS.—We notice that the Ministère des Postes et des Télégraphes, Rue de Grenelle Saint-Germain, 103, à Paris, is seeking tenders till the 22nd inst. for the supply of telegraphic sending and receiving apparatus as follows:—120 Hughes's apparatus, 1,400 Morse receivers, 10 transmitters, 10 Wheatstone receivers and perforators, 1,300 galvanometers, 60 resistance boxes, and 30 condensers, &c.; sundry necessaries for telegraphic offices, including 2,950 commutators, 2,600 lightning conductors of different kinds, 10,000 brass terminals, 800 oak boxes, &c.; to supply chemicals, &c., for batteries, &c., including 41,000 glass jars of different shapes, 54,000 porous jars, 100,500 zincs of different sorts, 8,000 kilos of byoxide of manganese, 50,000 kilos of sulphate of copper, 600 kilos of copper wire, covered with gutta percha.

THE ORIGIN OF THERMO-ELECTRIC CURRENTS.—According to our contemporary *l' Electricité*, M. Exner, of Vienna, has discovered that a bismuth antimony pair immersed in a gas incapable of acting chemically on either of these metals yields no current when one junction is heated. Also that if two bars of copper are soldered together to form a "pair" no current is produced when either junction is heated in air (as would be expected in a circuit of one metal), not even when both strips are exposed to the action of chlorine; but that if one strip only is exposed to chlorine gas and then one junction be warmed a thermo-electric current is set up. According to Exner, therefore, all so-called thermo-electric currents are due to chemical action. It would be easy for some of our ardent young physicists to put to the test this very remarkable announcement, and see whether it is Herr Exner, or all the authorities on thermo-electricity from Seebeck to Tait, on whom we are to rely for the facts.—*Nature.*

ELECTRICAL PAVEMENTS FOR CITY LOCOMOTION.—The latest suggestion for the use of electricity as a motive power is to have the streets of cities paved with iron, either in blocks or so arranged that the pavement will form continuous electrical conductors, divided into suitable sections, each section to be charged with electricity by a stationary steam engine and dynamo machine of proper size. On the electrical pavements thus provided, waggons, carriages, fire engines, omnibuses and other vehicles, each provided with an electrical driving wheel, and taking electricity through the wheel from the pavement, may be run, in any desired direction, with more ease and certainty than by the present system of horse locomotion, although that system would not necessarily be interfered with, as those who preferred to use horses could, of course, do so. Iron pavements could doubtless be made that would be quite as serviceable as the present stone blocks. The subject presents a fine opportunity for students of electricity to exercise their head gear.—*Scientific American.*

THE MAJORCA CABLE.—"The most important public work of the year 1879," says H.M. Consul at Palma, "was the re-establishment of telegraphic communication with the Peninsular. In former years the Balearic Islands enjoyed the use of two submarine cables, one from Santa Pomya, in Majorca, through Ibiza to Jávéa; the other through Menorco to Barcelona. Some years ago the latter ceased, through age, to be serviceable, and was never replaced, while in June, 1878, the latter, at a point between Majorca and Ibiza, also stopped working, thus placing the province entirely at the mercy of a never very carefully carried out postal system. After a year's delay the Spanish Government concluded a contract with an English telegraphic construction company, [Messrs. Henley and Co. ED. *E.*], and in June, 1879, an attempt, which unfortunately proved unsuccessful, was made to lay a new cable. Another attempt in November was more fortunate, and on the 24th of that month telegraphic communication was re-opened. The new cable is said to be of excellent quality, and gives every satisfaction."

INFLUENCE OF ELECTRICITY ON BACTERIA.—Some new experiments with regard to the influence of electricity on bacteria have been published by Professor Cohn, who adopted the method of sowing with bacteria a sterilised mineral nutritive solution, subjecting them to electric currents, and noting the results. A Marie-Davy flask element he finds to exert (according to strength of current) either no influence on the increase of bacteria, or merely a retardative influence. On the other hand, the current from two powerful elements sterilised the nutritive solution completely at the positive pole in twelve to twenty-four hours, so that afterwards the bacteria introduced did not increase. At the negative pole, the action was weaker, the liquid not completely sterilised. At neither of the poles were the bacteria killed, and when brought into another nutritive liquid they developed normally; on the other hand, yeast cells, and mycelium fungus brought into the liquid that was sterile for bacteria increased plentifully at the positive pole. A battery of five strong elements killed the bacteria distributed in the liquid within twenty-four hours, and sterilised the liquid of both poles.

WESTERN UNION TELEGRAPH COMPANY.—The board of directors have declared a quarterly dividend of $1\frac{3}{4}$ per cent. upon the capital stock from the net earnings of the three months ending June 30, payable on and after July 15 next. The official statement of business for the quarter is as follows:—The quarter closes the fiscal year and shows an increase of over 1,600,080 dollars in gross and 1,060,000 dollars in net earnings over the previous year ending June 30, 1879. The net profits for the year will be about 5,300,000 dollars (over $11\frac{3}{4}$ per cent. on the capital stock after deducting fixed charges for interest and sinking fund), out of which 8 per cent. in cash dividends will have been paid to stockholders, and 1,543 dollars invested in new property, with an increase of about 40,000 dollars in the surplus over that of July 1, 1879. The surplus, after paying dividends, is 810,714 dollars. The outlays for new property required by a largely-increased business are said by the report to have been unusual in amount, involving extensive purchases of telephone exchange property, and to increase the telegraph service over 3,500 miles of poles and 24,500 miles of wires have been constructed. A great proportion of this wire, it is stated, is of a larger size than ever before used in America, being especially adapted for quadruplex use.

CONSTRUCTION OF GUARD-RING ELECTROMETERS.—Mr. G. F. FitzGerald, in a note to the Royal Dublin Society, says:—"Guard-ring electrometers have usually been constructed with an aluminium disc, for the sake of lightness, surrounded by a guard-ring of brass. It is essential for the accuracy of the calculation of the absolute values of capacity and quantity made with them that the electricity should be as uniformly distributed as possible on the surface of the disc and guard. It is for the sake of producing a uniform distribution on the disc that the guard is added. Hence any arrangement which disturbs this uniformity of distribution is to be avoided. Now, whether the contact of dissimilar metals in itself produces an appreciable difference of potential between them, or whether it is the air near different metals that is at different potentials, there is no doubt that when the plates of an

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accumulator are of different metals there is an appreciable accumulation of electricity upon them. Consequently, in the guard-ring electrometer the distribution of electricity on the aluminium disc cannot be the same as on the brass guard connected with it. It might seem as if the other plate should be of the same material; but as it is generally easy to apply the differential method of measurement, a constant, even though unknown, difference of potential between the plates is of no consequence."

An Imaginary Telegraphic Culprit.—We are glad to be able to contradict the statements which have appeared in several American and English papers as to the alleged misdeeds of a supposititious ex-telegraph clerk, by name Thomas Hollister. This individual was stated to have been arrested at San Francisco on a charge arising out of the following proceedings:—He had conveyed a galvanic battery and an insulated wire to a desolate spot in the Sierra, not far from Battle Mountain, where he proposed to cut the service wires connecting California with the Eastern States, and, by means of his own apparatus, to telegraph the following amazing despatch to the agents of the Press Association at Chicago: "This morning about ten o'clock a huge tidal wave swept over San Francisco, destroying the entire city, and surging up further inland until Sacramento and Stockton were flooded ten feet deep. Simultaneously a fearful earthquake convulsed the whole State, the heaviest shock being sustained by Virginia City and its neighbourhood. Comstock Mines completely choked up. Further details of catastrophe as yet wanting." The inventive powers of the author of this story may perhaps inadvertently have been productive of some good by calling attention to the possibility of some occurrence similar to the above, and to the means of guarding against it by a password or otherwise. In the above case the object was supposed to be the creation of a Wall-street panic in Pacific Mail and Mining Company's stock.

Use of Smithson's Pile for the Detection of Mercury in Mineral Waters. By J. Lefort (*Compte Rendus*, 90, 141–143).—Orfila objected to the voltaic couple of tin and gold, devised by Dr. Smithson, for the detection of small quantities of mercury, alleging that when it was allowed to remain for some time in the suspected solution, traces of tin were dissolved, which, redepositing upon the gold plate, caused the latter to become whitened even in absence of mercury. The author shows that this deposition of the tin is liable to take place, but that no real error can result, since the metal not being volatile cannot be sublimed. There is, therefore, no sublimate to be submitted to the vapour of iodine, whereby an essential part of the operation as conducted by Smithson is omitted. Such, however, is not the case with arsenical solution; the arsenic deposits upon the gold with great readiness, and the coated foil when heated in a closed tube yields a sublimate, which, although not exactly resembling the mercurial sublimate, becomes red from formation of arsenic iodide when acted on by iodine vapour. The colour of the arsenic iodide under these conditions is very similar to that of mercuric iodide, and it becomes necessary to use the microscope in order to distinguish them. The water from the Rocher spring at St. Nectaire (Puy-de-Dôme) was examined by this process some time ago, and was stated to contain mercury. This statement is now contradicted, it being shown to contain arsenic and not mercury. In a similar manner the presence of arsenic has been detected in the mineral water of Bourboule; and doubtless this element might be shown to be present in many other waters if they were carefully examined by this process, or by some other method of equal delicacy.

Dots and Dashes.

Dancing dots, prancing dashes,
Going, flying onward flashes;
Trembling, bumping, ever thumping
'Way, 'way the roads are jumping.

On, on, with ne'er a tarry,
Fast, fast, with faithful carry;
Ever flopping, never stopping,
Holding all—never dropping.

Wriggling on, always throbbing,
Swift and sure words are bobbing;
Over the hill with a trill
Fleets the sparks at lightning will.

Bad news weighted, good news freighted,
Together flee—together mated;
Nervous singing, noises ringing,
Bad and good to people bringing.

Oh! the kicking, sharp the clicking,
Past the dark from science picking;
Making small the earth's domain,
Circling o'er its face again.

Thickly, quickly, beyond and over
Flashes on this lightning rover;
East, west, north and south,
Giving news with open mouth.

Helter skelter, mussing, fussing,
Rising lively, seldom cussing;
Brushing, crushing, little marks!
Skimming, swimming, little sparks.

—*Journal of the Telegraph.*

Postal Telegrams.—The following petition has been transmitted by the Council of the Society of Arts to the Postmaster-General: — To the Right Honourable Henry Fawcett, M.P., Her Majesty's Postmaster-General. The Memorial of the Council of the Society for the Encouragement of Arts, Manufacturers, and Commerce respectfully sheweth that the Council are strongly of opinion that the time has now arrived when the charge on inland telegrams might be reduced, and a minimum charge of sixpence substituted for the present one of a shilling. They submit that the charges on inland telegrams in this country are higher than in other European countries, the rates in France, Germany, Belgium, and Switzerland, all being lower than in England. It is even a curious anomaly that a telegram can be sent from any part of the United Kingdom to Belgium or to France for less than the smallest sum for which a telegram may be sent from one part of London to another. The Council do not propose to make any suggestions as to the details of the method by which the reduction of charge should be effected, whether by employing a lower tariff within certain limited districts, such as the metropolis and its suburbs, or the country within a certain radius of a provincial town; or, secondly, by adopting a word tariff, with a minimum charge of 6d. The precise details are, the Council feel, safely to be left to the department itself. They feel sure, however, that a reduction in the tariff would be accepted as a boon by a large number of those who are prevented by the present rates from using the telegraph as largely as they would wish, and that the business of the department would soon be so increased as to fully compensate for the lessened revenue which might be the first consequence of the proposed change.—(Signed) Alfred S. Churchill, chairman of the council, and H. T. Wood, secretary.

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REPORT.

We mentioned last week that one vessel had sailed on the expedition to lay the new cable for the Anglo-American Company, we now hear that so far "all is well."

The report of the Eastern Telegraph Company's meeting will be found in another column. The report of the directors of the Cuba Submarine Company also given in this week's issue is satisfactory.

We have had strong recommendation from readers to extend the scope of this paper, and to discuss certain questions which, although not directly of an electrical character, would be useful and interesting to our many foreign subscribers. A plan to do this is under consideration.

The electric light, as we pointed out in a leader a short time ago, is making good headway. Improvements are steady and continuous. One of these we saw on Tuesday last at the *féte* of the Butcher's Provident Institution at Walham Green. Mr. Crompton lighted the grounds by means of two of his lamps. Each lamp was connected to a Gramme machine, one of the Gramme's being of the old A pattern, the other larger, and with the various recent modifications. One of Mr. Crompton's lamps was fixed to the chimneys at the end house. The other was at the top of a specially devised apparatus. We may say that this piece of simple apparatus has been devised for railway purposes, and can be erected in a few minutes. It consists of hinged ladders, which when open stand at a height of about 34 feet. Each side-ladder is in two parts, for convenience of carriage, and the whole is kept rigid by a simple system of cross bracing. The ropes attached to the apparatus are of cotton, which, says Mr. Crompton, he had a difficulty in getting, such ropes being obtainable only from yacht builders, and they look upon the letting outsiders have such ropes as something of a favour. Outside this ladder apparatus at the top is braced a stanchion of iron, to which is fixed a rod to support the lamp. As Mr. Crompton uses thin, fragile French glass for his lamps, he found it necessary to arrange his apparatus that little danger of breaking should exist. The lamp is raised by two guide pulleys away from the ladder, and then swung round into its place. The glass plate at the bottom of the lamp is hinged so that the putting in of new carbons presents no difficulty. The carbons used are large in diameter, as experimental records have shown Mr. Crompton that the best results are obtained from the use of such carbons. In all probability similar lamps and apparatus will be used at the volunteer encampment at Wimbledon, and we believe the North Western Railway Company has ordered two sets of the apparatus, in order to give it a thorough trial.

Those interested in gas and gas shares will be found making a strong protest against the further introduction of the electric light into the City. But protests and pressure will alike fail to stop the inevitable. Sooner or later gas must give way in the open to a better light, and it will be well if this is seen and useless contentions avoided.

The price of gutta percha is quoted this week at per lb.:—Genuine 2s. to 3s. 6d., reboiled 3d. to 1s. 9d. India rubber is quoted per lb.:—Para (fine) 3s. 8d., negrohead 2s. 10d., Central American 2s. 3d. to 2s. 7d., Assam and Pegu 1s. to 2s. 4d., other East Indian 1s. 9d. to 2s. 4d., Madagascar and Mozambique 2s. 3d. to 2s. 8d. Sales are flat.

A PRELIMINARY ACCOUNT OF THE REDUCTION OF OBSERVATIONS ON STRAINED MATERIAL, LEYDEN JARS, AND VOLTAMETERS.*

BY JOHN PERRY AND W. E. AYRTON.

(CONTINUED FROM P. 89.)

Our theory for strained beams and twisted wires we have tested to about the same extent as Professor Clerk Maxwell's theory for Leyden jars has been tested, and we find the same kind of confirmation. For example, the following is one of the many experiments we tried:—

September, 1877.

A circular glass rod 128 centims. long, 0·832 centim. in diameter, rested on two knife edges 117 centims. apart, and was loaded with a weight of 400 grms. hung at its centre. The deflections of the rod were observed by a ray of light coming from a rigidly fixed lamp, falling on a mirror rotated by the bending of the rod, and reflected on to a rigidly fixed vertical scale. To prevent errors arising from slight alterations of the position of the flame it was always focussed so that the image of two cross-wires fixed in the lamp slit and formed by a fixed lens always occupied the same position when not reflected by the mirror attached to the deflected rod, and it was the position of this image after being reflected by this mirror which was observed on the vertical scale. After the beam had been loaded for 145·55 hours, observations of the increasing deflection being taken all the time, the load was removed. For several hours after the load had been removed the actual observations themselves needed very little correction by drawing a curve; afterwards the slight waviness of the true curve due to changes of temperature had to be eliminated. In the several tables of observations of loaded and relieved beams (each experiment lasting two or three weeks) we have given the temperature of the room at the time of making the observation.

By the method of reduction adopted, we find that during the recovery of the rod from t equal 20, to t equal 240 ($1 = 1{\cdot}25$ hours) the curve is almost purely logarithmic, and we find by calculation that

$$w_1 = 10{\cdot}6 + 224{\cdot}79\,\epsilon^{-0{\cdot}01296\,t},$$

and the column of values of $(w - w_1)$, in the following table shows that this expression satisfies the observations very accurately for a very long period, namely, 220 on our scale of time, or 275 hours. Taking these numbers, we have calculated w_2, the next term in the solution of the differential equation, and find that

$$w_2 = 138{\cdot}7\,\epsilon^{-0{\cdot}3125\,t},$$

so that the last column of the table shows the inaccuracy of the assumption—

$$w = 10{\cdot}6 + 224{\cdot}79\,\epsilon^{-0{\cdot}01296\,t} + 138{\cdot}7\,\epsilon^{-0{\cdot}3125\,t},$$

an inaccuracy which is of very little importance from

$$t = 2{\cdot}4 \text{ to } t = 240,$$

and even this inaccuracy we have found is to some extent due to the fact that the temperature of the room was steadily falling at that time from 26°C. to 21° C.

Recovery of the Glass Beam after being loaded for 145·55 hours with 400 grms.

Time ($1 = 1{\cdot}25$ hours) reckoned from removal of load.	Observed value of w.	$w - w_1$	$w - w_1 - w_2$
0 load on	6475·0		
load off			
0·005	600		
0·4	411·3	177·0	154·4
1·4	340·8	109·4	19·9
2·4	300·6	71·9	6·5
3·4	275·6	49·9	1·9
4·4	278·5	35·6	0·5
5·4	246·3	26·1	0·4
6·4	237·1	19·7	0·9
8·0	224·6	11·4	0·0
10·0	214·2	6·2	0·1
12·0	206·9	3·9	0·6
14·0	200·6	2·5	0·8
16	195·0	1·7	0·8
18	189·8	1·2	0·7
20	184·5	0·4	0·1
30	162·8	−0·2	−0.2
40	145·3	0·8	0·8
50	131·0	2·8	2·8
60	116·3	2·4	2·4
70	103·2	1·9	1·9
80	91·5	0·2	0·2
90	81·2	0·6	0·6
100	72·3	0·2	0·2
110	64·7	0·1	0·1
120	58·0	0·0	0·0
130	52·5	0·2	0·2
140	47·7	0·5	0·5
150	43·3	0·5	0·5
160	39·3	0·4	0·4
170	35·8	0·4	0·4
180	32·7	0·3	0·3
190	29·8	0·0	0·0
200	27·3	−0·1	−0·1
210	25·1	−0·3	−0·3
220	23·2	−0·4	−0·4
230	21·6	−0·4	−0·4
240	20·0	−0·4	−0·4

There cannot be much doubt of the fact that electric induction through dielectrics and magnetisation of iron are really phenomena of stress and strain, and it is probable that the correct-

* Read before the Royal Society, May 27.

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ness of Ohm's law when applied to dielectrics is dependent on the theory of continued strain, which we have just given, and which we are attempting to prove. In addition to experiments such as we have described, we have been making others to find whether beams which are kept in a state of strain rise in temperature through internal friction, which is of course analogous with electric resistance, and in addition to see whether a soft steel magnet acted upon by a constant current also rises in temperature; but hitherto these heating effects, if they exist, have been too small for our instruments to detect. In speaking of beams we refer especially to glass beams; a beam of sealing wax would probably, under the same circumstances, perceptibly rise in temperature.

As a further example of the reductions which we are describing in this paper, we give a table of observed and calculated values of the diminishing deflection of a glass fibre, which had been twisted for some days, and then released. The fibre was 85 centims. long, of a mean diameter of 0·034 centim. suspended vertically, so that its upper end could not turn in the support, and carrying a weight of 211·6 grms. Attached to this weight was a vane dipping into water to diminish the rapidity of the swings.

The untwisting of the vertical glass wire was observed by the reflection of a ray of light, coming from a fixed lamp, by a mirror rigidly attached to the wire at its lower extremity. The spot of light, or rather the image of the cross wires in the lamp slit, moved over a horizontal semicircular scale graduated in millimetres, and one metre in radius, with the mirror turning at its centre. An arrangement similar to that employed in our deflected beam experiments was used to obviate errors arising from difference of position of the flame of the lamp on different days.

The mirror and the weight having been kept twisted through a right angle for about a week, the deflecting couple was suddenly removed, and time readings of the diminishing deflections taken. As at first the deflection diminished with considerable rapidity, and as in addition the spot of light described a series of oscillations about the varying mean position, the system of registration we employed was as follows:—The position of the spot of light on the scale at the end of every swing was observed as accurately as possible, and the time recorded by simultaneously pressing down the key of a "break circuit chronograph." From these successive time observations of the swings about a varying mean position the true curve was drawn in accordance with a method mathematically developed by us.*

The reduction of this curve by the method previously explained leads to the equation

$$w_1 = 72{\cdot}8 + 35{\cdot}55\,\epsilon^{-0{\cdot}0569\,t},$$

where w_1 is the deflection, and t the time from the moment of removing the deflecting couple, the unit of t being 20 seconds. Several of the earlier observations have been omitted in the following table, as it is not until after 40 seconds that the above equation represents accurately the torsional strain. From this time, however, until the end of the experiment, the equation is very accurate.

Recovery of Glass Wire previously subjected to Torsional Strain. November 16, 1876.

Time from moment of removing deflecting couple.	Observed deflection w.	w_1 calculated from formula.	Difference $(w-w_1)$.
0·7	143·5	107·0	36·5
1·0	131·5	106·4	25·1
1·5	118·4	105·4	13·0
2	110·4	104·5	5·9
3	102·9	102·8	0·1
4	100·4	101·1	0·3
5	98·7	99·5	−0·8
6	97·2	98·1	−0·9
7	96·0	96·7	−0·7
8	95·0	95·4	−0·4
9	94·0	94·1	−0·1
10	92·9	92·9	0·0
11	91·9	91·8	0·1
12	90·8	90·8	0·0
13	89·9	89·8	0·1
14	88·8	88·8	0·0
15	88·0	88·0	0·0
16	87·1	87·1	0·0
17	86·3	86·3	0·0
18	85·6	85·6	−0·1
19	84·9	84·9	0·0
20	84·3	84·2	0·1
21	83·6	83·6	0·0
22	82·9	83·0	−0·1
23	82·2	82·4	−0·2
24	81·9	81·9	0·0

* *Journal Soc. of Telegraph Engineers*, vol. v., 1877, p. 391.

As a further example of the reduction by our method of the results of observation, we give five tables of experiments made with a special form of voltameter devised so as to enable experiments to be made with a gas-freed liquid, or a liquid more or less saturated with any particular gas, and with the platinum plates previously free from gas, or made to occlude any special gas.

The voltameter itself was something like the upper part of a Geissler's mercury pump; that is, by lowering a column of mercury the electrolyte could be lowered from the platinum plates, leaving them in a vacuous space. The electrolyte of course commenced to boil, and to rapidly free itself from gas. By a valve this gas was allowed to escape, on again raising the mercury column, and the liquid above it. This operation being repeated a number of times, the liquid being left for a considerable period under the vacuous space towards the end of the operation, a large portion of the gas in the liquid could be removed.

In order to remove the gas occluded in the platinums they were not, as is usual in voltameters, made in the form of plates, but each was a platinum spiral, the two ends of which protruded to the outside of the voltameter. By means of a small Grove battery, each of these spirals could be made red hot in the vacuous space produced when the electrolyte was lowered, and thus a voltameter was obtained with gas-freed platinums in a gas-freed liquid, or by subsequently bubbling through a stream of a particular gas, with platinums in a liquid, with more or less at will of that gas occluded.

As these platinum spirals presented but a small surface, and as they were necessarily some little distance apart, the currents charging and discharging such a voltameter, when only one Minotto's cell was employed, were rather small, so that it was necessary to employ a fairly delicate reflecting galvanometer. From the first elongation of the spot of light on charging or discharging the voltameter, we could calculate the time integral of the current in the first half swing of the needle, and the subsequent time readings of the diminishing deflection were ascertained by an experienced observer, dotting with a pencil on the horizontal cylinder revolving uniformly (referred to at the commencement of the paper) the limits of the excursions of the spot of light in the successive swings about the varying mean position, the locus of which was subsequently drawn in by our method already referred to.

In the following table* u is the observed current flowing into the voltameter to charge it at the time t, from the moment of applying one Minotto's cell; the voltameter contained distilled water well freed from gas, and the platinum spirals were kept red hot for some time in the vacuous space, before immersion in the liquid. The solution of the general differential equation leads to

$$u' = 86{\cdot}2 + 85{\cdot}7\,\epsilon^{-0{\cdot}06245\,t},$$

which from the following table,* it will be seen accurately represents the charging current from t equal 7 to t equal 25. After the current had flowed into the voltameter for 1 hour and 7⅓ minutes the cell was removed, and the voltameter discharged through the galvanometer, the connexions of which were simultaneously reversed, so that the discharge deflection might be on the same side as the charge deflection, and therefore less swinging about of the needle produced at the moment of discharge. In the second of the following tables* u is the discharge current at a time t from the commencement of the discharge, and u' is calculated from the equation

$$u' = 30{\cdot}90\,\epsilon^{-0{\cdot}0553\,t},$$

which accurately represents the discharge current from t equal 5 to t equal 25. The two exponents in the solutions of the differential equation for the current flowing in during charge, and the current flowing out during discharge, are

$$-0{\cdot}06245\,t \text{ and } -0{\cdot}0553\,t,$$

which, considering that the resistance of the galvanometer, battery, and connections could not be neglected in comparison with that of the voltameter itself, are remarkably nearly equal to one another, being both—$0{\cdot}06t$ to two places of decimals.

When it was desired to measure the time integral of the discharge current during the first half swing of the galvanometer needle, rather than the deflections, a short time after the commencement of the discharge the galvanometer was short-circuited for a sufficient length or time before the Minotto's cell was removed for the needle to come to rest at zero.

(TO BE CONTINUED.)

* These tables will be given in our next issue.

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THE ELECTRICIAN.

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TELEGRAPHY AND "OUR BOYS."

"What shall we do with our boys?" is a question often mooted amongst the middle classes, as well as elsewhere; and on entering into it more fully telegraphy as a branch of engineering crops up to be discussed as a possible opening for a boy having some turn for mathematics, chemistry, or mechanics. When we are asked our opinion, we are puzzled what to answer, for there seems to be a haze over the subject. We do not know exactly where to point to a good and certain opening for a young man on whom some expenditure has been incurred to give him something of a scientific education.

Taking the Post Office, it appears that the only entrance must be as a manipulating clerk, from which position it would seem the chances of his rising beyond the position of a clerk in charge is very small indeed. The engineering branch of the Post Office, formed out of the old engineering staff of the Electric Telegraph Company, is young, and will not require recruiting for many years; but, moreover, from the fact of the main part of the wires being maintained by the railway companies, the staff required to supervise construction, maintenance, and testing is comparatively small. The Royal Engineers, too, are brought in to some extent at the top at once, thus absorbing some of the upper positions, while the old Post Office staff proper are pushed into prominence in all positions in which technical knowledge is not absolutely essential. To place a boy who has been educated in mathematics, chemistry, natural philosophy, &c., say at King's College or London University College School, as a Post Office telegraph clerk, with the view of his rising to the position of engineer or electrician, or assistant to those officers, seems much like educating a boy at the Royal Academy, Woolwich, and throwing him into the ranks of a line regiment with the hope that at some period he might rise up to become a colonel in the Royal Artillery or Royal Engineers. It appears to us that, although for a boy of ordinary capabilities and a minimum of technical education, there may be a chance of getting a living, and having some day charge of an office, or, perhaps, at a remote period charge of a district, there is nearly as much chance for one without any technical education as for one with it, and that it would be expecting too much patience of a lad with a fondness for science to make him work for years at sending messages, with the small chances of promotion to a position where his scientific knowledge would be of use, which the Post Office in its present organisation affords. Indeed, we have known several in other positions who had left the Post Office service, seeing the very hopeless prospect before them. It seems, however, strange that there should not be some means of recruiting the scientific and engineering branch of the Post Office Telegraphs without the candidates having to wade through years of working at the instrument, as it is evidently improbable that many lads who have received a good and technical education would not find some better opening than that of telegraph clerk where the number of clerks required is so great, and the chances of rising to the engineering staff so excessively small. Manipulating an instrument has very little to do with the construction of lines and instruments, and although every electrician should know how to send, and should be made to learn this duty, it seems that to become a telegraph engineer he ought to be learning a hundred other things of much greater importance, and that if he must enter as a telegraph clerk he cannot possibly learn anything else but manipulating, at any rate during business hours, for years and years. We should think, therefore, that unless some change in the organisation takes place the Post Office engineering staff must eventually deteriorate.

Next let us consider the great submarine telegraph companies. Here there is a little better scope, for there is some accurate testing to be done, and a clerk having some technical knowledge may come to the front, and, after proving practically that he can localise faults, may have to go away in a repairing ship, first as electrician, and then in charge of the repairing operations, and eventually become electrician in chief in charge of several long sections, having a repairing ship at his disposal and receiving a salary of perhaps £500 to £800 a year. The School of Telegraphy teaches the working of the syphon recorder and mirror and the general principles of testing, and from this institution many young men have entered the large submarine telegraph companies. Those that look to this branch must, however, be prepared to go abroad at once, and rarely to see England for many years; but the pay and chances of promotion appear to us infinitely superior to the chances in the Post Office, as the lines are constantly on the increase, affording the means of promotion.

Then we have the large submarine telegraph contracting firms, such as the Telegraph Construction Company, Messrs. Siemens Brothers, the India Rubber, Gutta Percha, and Telegraph Works Company, and W. T. Henley and Co. All these firms have a certain amount of staff, the first-named

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having by far the largest. The engineers and electricians who go away in charge of expeditions receive good pay, and have with them a large staff of assistants. All these must be recruited as time wears on and work increases, and there is in this work fair scope for a young man having technical education, and a talent for invention in improving the mechanical and electrical appliances, as the contracting firms are ever ready to make alterations where safety or economy is gained.

We have still to mention the purely professional firms, who, acting as engineers for the large telegraph companies, draw up specifications for the work to be performed, and inspect and report on the works executed by the large contracting firms we have mentioned. Thus we have Messrs. Clark, Forde, Hockin and Taylor, Messrs. Sir William Thomson and Fleeming Jenkin, and Messrs. Sir S. Canning and R. Sabine. This line is that in which purely scientific knowledge is of the greatest use, but the number of assistants required is so limited that it hardly constitutes an opening.

Each large English railway company has a telegraph staff under a telegraph superintendent, and there is a chance here for some young men, but the promotion must be very slow. Lastly, the telephone or electric light must engage the services of a good many young electricians, but how far these are good openings for young men seems at present quite uncertain.

Taking telegraphy as a branch of professional engineering, it cannot be said to have the same chance of money-making that regular civil or mechanical engineering presents, for in fact there is only one professional firm who can be said to have a good practice, whereas, of course, there are hundreds of firms in civil and mechanical engineering with ten times that practice; but for young men who will be contented with reaching the position of an *employé* on a salary of £500 to £800 a year, and even more, there are several openings, as we have pointed out, where they would have a fair chance, provided they are steady and energetic, and will continue to study and work with due perseverance. In contracting and patenting there is, of course, money to be made, but this is outside the question of what opening there is for a young man to rise steadily up in some branch of telegraphic engineering.

AN IMPROVEMENT IN THE SIEMENS ARMATURE.

When we get the dynamic diagram of a Siemens bobbin, by making it operate through an entire revolution between the two poles of the electro-magnets which act upon it, we see that the work is almost *nil* during two considerable portions of the rotation. These two periods correspond to the times during which the cylindrical poles of the bobbin, having attained the poles of the magnet, defile before them. During these two fractions of a revolution, which are each about 30°, the magnetic surfaces destined to react upon each other, remain at the same distance. The bobbin is not then urged to turn, when it is being driven by the transmitted current from a second machine, and the result is a notable loss of work done.

These indifferent periods have, however, been suppressed by M. G. Trouvé, the well-known French electrician, and the usefulness of the machine thereby much improved. This has been effected by modifying the bobbin in the following manner:—The polar faces, instead of being portions of a cylinder of which the axis coincides with that of the system, are in the form of a *limaçon* or "snail," so that in turning they approach gradually their surfaces to those of the magnet until the moment when the posterior edge escapes from the pole. The action of repulsion then commences, so that a "dead point" is practically avoided.

The importance of this improvement has been shown by a very simple experiment. Two Siemens bobbins of the same diameter have been constructed, of the same length and wind, one only being modified in the way described. These have been successively tested by substituting them for one another in an electric motor, and it has been proved that with the same battery power the modified bobbin gives a considerable increase of work over the other.

The bobbin can act in presence of a permanent magnet, but M. Trouvé prefers to employ as a fixed magnetic reacter an electro-magnet placed in the same circuit, which permits the energy of the current to be varied between far-apart limits without the respective magnetic intensities of the fixed and movable organs ceasing to exist in the relation desired.

At a recent meeting of the French Academy M. Trouvé exhibited a small motor constructed upon this principle, and a single cell of Regnier's battery (described in our issue for July 10) put it into rapid rotation and drove a sewing machine; in fact, the instrument with the cell formed a promising little household motor; moreover, it is reversible in its action, and can be made a generator of electricity.

THE THEORY OF THE TELEPHONE.

An interesting communication bearing on the theory of the telephone has been made to the French Academy of Sciences by MM. Ader and Du Moncel.

Our readers will remember that in 1879 M. Ader constructed a telephone without a diaphragm, the sound being given out by a soft iron wire enclosed in a helix, through which the current passed. The action was explained by M. Du Moncel to longitudinal vibrations in the wire resulting from successive lengthenings and shortenings of the wire under the action of the magnetising helix, it being well known that an iron core is lengthened by magnetisation. M. Du Moncel employed this fact to support his molecular theory of the action of the Bell telephone. Since that time M. Boudet, of Paris, has, by means of his sensitive microphone, succeeded in revealing these changes of length. Moreover, M. Ader himself has investigated the subject very closely, and, besides measuring the effect in question, has arrived at the important principle that *all bars of a magnetic nature submitted to a mechanical action, be it compression, torsion, or tension, tend to recover their primitive molecular arrangement under the influence of the current which magnetises them.*

The apparatus employed by M. Ader in his experiments consists of a small straight electro-magnet, having its core formed of an iron wire 0·04 or 0·05 mètres long, and one extremity chamfered off. Upon this chamfer acts a long lever, which serves the double purpose of an indicator and exciter of the mechanical action. The lever terminates in an index which moves itself before a graduated scale (in front of which is a lens), and is connected to the magnetic core in a manner differing with the mechanical action to which the latter is submitted.

In the cases where compression and tension are produced, two distinct effects are seen. On allowing the current to flow for several instants continuously, the index is gently displaced, moving up the scale in the former case (compression) and down the scale in the latter case (tension), with a deflection proportional to the intensity of the battery and the time of closure of the current. This effect is evidently due to the dilatation of the core in each case under the influence of the heat developed by the current, for it is obtained with a core of copper. On closing the circuit momentarily the lever rises instantly in both cases, and instantly falls on the current being interrupted. At the same time a "dry" sound can be perceived at each make and break of the current when the ear is applied against the table supporting the apparatus. But the apparatus is so arranged that the displacements indicated in the two cases correspond to two mechanical effects diametrically opposite in character; that is to say, to a lengthening and shortening of the core. It can, therefore, only be due to a molecular action tending to annul the mechanical strain on the core in either case.

In the case of torsion, the index rises always at the moment of making the circuit and falls again at the moment of breaking it, and in a degree corresponding to the force of the mechanical action, as can be determined by a weight sliding on the torsion lever. In this case the thermal effect is not shown at all, since the indicating lever does not change its position by reason of the lengthening or shortening of the magnetic needle. The magnetisation in this case tends, as in the experiments of MM. Guillemin and Coulon, to untwist the wire.

The length by which the core is shortened by closing the circuit momentarily by the current, according to M. Ader's calculation, is less than one ten-millionth of a mètre, or one ten-thousandth of a millimètre. It is greater under the influence of torsion, and less under the influence of tension.

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TELEGRAPHIC STATISTICS.

(FRENCH BUDGET FOR 1881.)

In the issue of the *Journal Officiel de la République Française*, dated 24th June in the present year, will be found a lengthy Report by the Budget Committee in relation to the French Postal and Telegraph Department, which contains a great amount of statistical information. Passing over that which refers particularly to the postal service, we will quote that which is of special interest to telegraphists :—

"TELEGRAPHY.

The position of affairs has considerably improved in relation to telegraphy, as will be seen by an inspection of the following table :—

YEARS.	NUMBER OF DESPATCHES.		General Total.
	Interior.	International.	
1877	7,206,250	995,234	8,201,484
1878	9,900,250	1,145,968	11,046,218
1st May, 1878, to 30th April, 1879	11,069,118	1,162,919	12,232,037
1879	12,344,775	1,211,416	13,556,191
Comparison between 1877 and 1879	Increase in favour of 1879 : 5,138,525	216,182	5,354,707
	Rate of increase per cent : 71·30	21·72	65·25
Comparison between 1877 and the first year of the reform (1878–1879)	Increase in favour of 1878–1879 : 3,862,868	167,685	4,030,553
	Rate of increase per cent. : 53·60	16·84	49·14
Comparison between 1878 and 1879	Increase in favour of 1879 : 2,244,525	65,448	2,509,973
	Rate of increase per cent. : 24·69	5·71	22·72

OFFICES.

The official statistics of the international office at Berne furnishes interesting data, relative both to the postal and the telegraphic services, from which we reproduce the following :—

Number of Telegraph Offices in 1878.

COUNTRY.	Number of Offices.	Number of Inhabitants to each office.	Number of square kilometres to each office.
Switzerland	1,091	2,446	37
Germany	8,222	5,196	65
Sweden	715	6,338	617
England	5,259	6,427	60
Denmark	250	7,138	157
France	4,772	7,733	110
Belgium	648	8,234	45
Norway	230	8,347	1,368
Austria	2,484	8,756	120
Netherlands	356	11,185	92
Italy	2,145	13,058	138
Hungary	960	16,059	335
Greece	82	17,779	612
Portugal	185	21,355	488
Roumania	183	27,540	875
Russia	2,326	38,574	9,551
United States	8,534	4,552	918
Japan	149	234,218	2,888

France stands sixth in order. The number of offices has increased, being at present 4,965, or one office for every 7,433 inhabitants and every 106 square kilometres. Nevertheless, the position of France on the list is not thereby altered.

The lengths of telegraph lines, inclusive of overland, subterranean, and submarine lines, was in 1878 as follow :—

COUNTRIES.	Length of line. Kilom.	Length of wire. Kilom.	Number of square kilometres for each kilom. of line.
Russia	75,455	143,796	294·42
Germany	60,103	219,990	8·97
France	59,407	165,616	8·89
Great Britain	41,307	183,440	7·67
Austria	34,603	88,381	8·67
Italy	24,830	82,676	11·93
Hungary	14,687	50,466	21·94
Sweden	10,930	28,346	40·40
Norway	8,467	14,856	37·18
Switzerland	6,523	15,960	6·35
Belgium	5,234	22,778	5·62
Roumania	5,196	8,214	30·82
Portugal	4,253	9,719	21·26
Netherlands	3,643	13,358	9·05
Greece	3,518	4,515	14·25
Denmark	3,376	9,016	11·66
United States	133,526	340,409	58·70
Japan	5,819	13,066	73·98

France occupies the third position in the first and second columns, and the fifth place in the third column. The proportion at the present time is 1 kil. of line per 8·4 sq. kil., giving to France the fourth place in the third column. The results of the telegraphic circular of 1878 are as follow :—

COUNTRIES.	Home Telegrams transmitted.	International Telegrams.			General Total.	Number of telegrams charged for and sent per 100 inhabitants.	
		Transmitted.	Received.	In transit.		In 1878.	In 1877.
Great Britain	21,723,268	1,232,041	1,119,032	138,226	24,613,364	67	61
Germany	8,575,916	2,241,763	2,470,400	602,190	14,540,553	25	25
France	10,373,476	1,158,597	1,260,863	421,521	14,414,457	31	22
Russia	4,374,508	470,027	476,141	67,915	5,761,731	5	5
Italy	4,361,139	354,493	369,065	206,257	5,670,843	16	16
Austria	3,563,294	649,455	641,766	233,053	5,094,175	18	18
Belgium	1,963,492	351,811	385,511	256,951	4,518,239	43	42
Hungary	1,876,126	554,208	578,169	144,957	3,298,308	15	13
Switzerland	1,590,108	298,728	290,312	227,569	2,476,788	70	84
Netherlands	1,644,908	334,549	369,006	44,979	2,413,338	49	50
Sweden	676,453	142,266	154,511	84,028	1,086,486	18	20
Roumania	518,283	184,659	186,370	8,145	1,072,622	13	11
Denmark	379,981	129,926	140,279	265,884	960,578	28	30
Norway	491,421	115,254	130,128	2,820	785,546	32	36
Portugal	356,941	55,940	60,697	82,666	641,810	10	9
Greece	290,736	25,035	31,259	37,127	390,974	21	...
United States	...	...	...	...	25,070,106	64	61
Japan	956,257	8,284	9,559	...	1,045,442	3	...

The proportion in France was, in 1879, 36 despatches for every 100 inhabitants.

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From the point of view of the postal and telegraphic service, France, as compared with some other European countries, shows a relative deficiency in regard to the number of telegraphic offices; but the creation next year of 250 new receiving stations will improve its position, especially if it perseveres in developing the organisation of the service. From the important point of view of the traffic, the place it occupies is creditable, and the progress realised within the last few years is interesting. From the purely telegraphic point of view this progress is equally considerable, and the statistics show that, comparing the years 1877 and 1878, the greatest increase in the number of despatches occurred in France.

Whilst the number of telegrams exchanged per 100 inhabitants remains the same in Russia (viz., 5), in Italy (16), and in Germany (25), the following *diminutions* occurred in 1878:—

1 despatch per 100 inhabitants in the Netherlands (49).
2 despatches per 100 inhabitants in Denmark (28).
2 despatches per 100 inhabitants in Sweden (18).
4 despatches per 100 inhabitants in Norway (32).
14 despatches per 100 inhabitants in Switzerland (70).

On the other hand, there was an increase over 1877 of

1 despatch per 100 inhabitants in Belgium (43).
1 despatch per 100 inhabitants in Austria (19).
1 despatch per 100 inhabitants in Portugal (10).
2 despatches per 100 inhabitants in Hungary (15).
2 despatches per 100 inhabitants in Roumania (13).
6 despatches per 100 inhabitants in England (67).
And 9 despatches per 100 inhabitants in France (31).

This considerable increase in the French telegraphic traffic is not a matter for surprise, since the result was anticipated as a consequence of the reform.

Technical Service.—Overland Lines.

The overhead telegraphic network in France comprised, on the 31st December, 1877,

55,500 kilometres of line.
145,000 kilometres of overhead wires.

On the 31st December, 1878,

57,000 kilometres of line.
158,500 kilometres of wire.

On the 31st December, 1879,

59,500 kilometres of line.
171,500 kilometres of wire, of which 2,500 kilometres were included under the head of concessions for private lines.

That is to say, there was an increase for 1878 of—

1,500 kilometres of line.
13,500 kilometres of wire.

And for 1879 of

2,500 kilometres of line, and
13,000 kilometres of wire.

These augmentations were distributed as follows, in the case of each year, over the different classes of lines:—

Designation.	1878.		1879.	
	Line.	Wire.	Line.	Wire.
International system	...	265	...	1,000
Principal interior system:—				
Main communication	105	2,740	500	4,000
Intermediary ditto	350	7,800	500	5,000
Auxiliary lines	65	450	50	400
Departmental systems	65	340	50	500
Cantonal systems	815	1,555	1,300	1,800
Various systems, comprising lines for private use	100	350	100	300
Corresponding totals	1,500	13,500	2,500	13,000

Parisian System.

The constructions carried out during the year 1878 alone necessitated the supply of 115,000 posts, 350,000 insulators, 350,000 brackets, 700,000 screws, and 2,700,000 kilograms of wire.

The construction in Paris of underground lines was commenced about 1860, and on Jan. 1, 1878, the total length of underground wire was 4,625 kil. 948 metres. Since that period 1,810 kil. 461 metres have been laid down, forming a total length of 6,436 kil. 409 metres of subterranean conductor.

The Paris system of lines is subdivided into three very distinct classes, viz.:

1. The administrative system, terminating at two of the main offices, the central post office and the Bourse.

The central post office is in communication with foreign countries, by means of 32 international lines, with the principal towns of France by 114 interior lines, and with the Paris offices by 73 urban lines.

The Bourse office is in communication with foreign countries by means of four international lines. (During business hours the central post office places at its disposal eight other lines, which then places it in communication with the principal Exchanges of Europe and with that of Lyon). It is also in communication with the offices of the *département de la Seine* through 35 interior (or home) lines, and with the Paris offices by means of 62 wires.

	kil.	m.
The wires bringing into communication the Paris offices have a length of	3,223	563
The wires passing externally have in Paris an extension underground of	2,430	730
2. The municipal system connecting the mayoralties, the prisons, the fire stations, the hospitals, the stations for water supply, and *pavillons de secours*. This system has a length of	650	000
3. The system of private lines established for individuals from time to time as applications are received from those interested. Its length is	132	116
The total being	6,436	409

The pneumatic system at present in work at Paris has a length of 77,600 metres. It is worked from six stations at which are located steam engines having a total power of 153 horses, and also a water apparatus. In addition to this there are six water-motors.

This service comprises a main system with double line, at which terminate seven supplementary systems with branches. The trains run every three minutes on the main system, and every five minutes on the supplementary systems.

The pneumatic system has 37 offices belonging to it and situated within the limits of the old *octroi*; 9 other offices within these limits also take part in this service; and the transmission and delivery of telegram-cards are accomplished through the intermediary of the nearest pneumatic offices.

The prepaid forms for transmission through the tubes were placed at the disposal of the public on May 1, 1879, with the following tariff:—

Open telegram-cards, 50 centimes.
Closed ,, ,, 75 ,,
Telegram-cards with pre-paid reply, introduced since April 5, 1880, 1 franc.

A decree dated May 22, 1880, has just reduced these charges:
From 50 centimes to 30 centimes for the open telegram-cards.
From 75 centimes to 50 centimes for the closed telegram-cards.
And from 1 franc to 60 centimes for the telegram-cards with reply prepaid.

This is a new improvement which will be very much appreciated by the Parisian public.

The following table shows how far the pneumatic service has utilised in the period from May 1, 1879, to February 29, 1880:—

Designation.	Number of Telegrams.	Mean per month.
Despatches from Paris for Paris:		
Telegram-cards	150,954	15,095
Closed telegrams	40,305	4,030
Ordinary telegrams	209,654	20,965
Total	409,913	40,090
Despatches exchanged between offices in old Paris and the exterior of Paris:		
Despatches from the exterior for Paris	1,648,190	164,819
Despatches from Paris to the exterior	1,863,520	186,352
Total	3,511,710	351,171
General total of traffic	3,912,623	391,262

The telegram cards have not been utilised to the extent that

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was to be expected of a service which offers a greater promptitude of transmission in addition to the power of sending as many words as the telegram card can receive; its size being the same as that of the postal card. The reduction in the price of these despatches will aid much in popularising them; the public has not yet relinquished the habit of using the ordinary telegram.

The Minister of Posts and Telegraphs proposes to extend the pneumatic system to the communes annexed to Paris in 1860; the total expense is estimated at 1,866,000fr. and would be distributed over three years, as follows:—

1881.	Execution of the works at Grenelle, Passy-Auteuil	450,000
1882.	La Chapelle, la Villette, cattle market, Belleville, and new machines at the Bourse	616,000
1883.	Batignolles, avenue de Villiers, place d'Eylan, avenue de Friedland	450,000
1884.	Vangirard, Montrouge, Gobelins, Bercy	450,000

Telephonic System.

Outside of the ordinary concessions for private lines, a ministerial order of the 26th June, 1879, regulated the conditions for concessions relating to telephonic lines in Paris, and a few other large towns.

Up to the present time, three concessions have been granted in this direction, all of them for the interior of Paris, and without any kind of privilege.

The development of the telephonic system at present comprises:—

56 *k* 215 metres of overland wire,
160 *k* 943 metres of underground wire.

Private Lines.

Until 1878 the concession of telegraphic lines for private purposes was not subjected to any fixed rules.

A project of regulation, which had been under consideration since 1864, was never definitively adopted. The conditions imposed upon concessionaires were variable. The administration had even completely relinquished its rights in regard to a portion of these concessions by handing them over to the discretion of prefects, who sometimes accorded them gratuitously.

In reality these lines were conceded only after long solicitation, and, so to speak, reluctantly.

From 1872, the payment made by concessionaires was generally 30fr. per kilometre of wire. In the course of the year 1874 this was considered insufficient, and the payment was raised to 50fr. The consideration which this payment represented was the undertaking on the part of the State to construct and maintain the lines; but there was no charge upon the communications exchanged between individual firms through private lines, in order to indemnify the State for the abandonment of its monopoly.

This condition of things was altered by the decree of 13th May, 1879. The right of granting concessions is now vested in the minister only; and the conditions under which they are accorded are definite and invariable.

The concessionaire is bound to pay annually:—

1. 12 or 20fr. per kilometre, according as the wire is attached to the Government posts, or on special posts. This payment is made for maintenance, which is undertaken by the State. The erection of the line is at the cost of the concessionaire.

2. 50fr. per kilometre up to the twentieth kilometre, and an additional 25f. beyond 20 kilometres, for wires which do not terminate at a government station. This payment represents the right of usage, the legal charge upon the telegrams; the ordinary tariffs are applied in the case of lines terminating at a government station.

In England and in Germany the charges are heavier. They are equivalent in England to a charge of 78 fr per kilometre, and in Germany to one of 100 fr.

This reorganisation was well received. Thus, up to 1878, in fifteen years, there were 199 concessions for private lines, or a mean of 13 pr ann. In 1879, eighty-three concessions were granted; and in 1880 there have been thirty-six concessions since the 1st of January.

Telephonic Lines.

According to a report made to the Emperor of Germany, particular attention has been given in that country to the application of the telephone for the exchange of communications. The first trials were made at Berlin, Nov. 5, 1877, with the Bell telephone. Trials made subsequently on a larger scale gave such satisfactory results that at the end of March 1879 there were 389 telephonic offices in full activity within the German empire, and it was intended further to extend their number. In this service a comparatively small amount of training and technical knowledge is required, a circumstance which renders it possible to confer the benefits of telephony upon small localities at a small cost. It was stated that the possibility of transmitting communications through so great a distance as 75 kilometres had been placed beyond doubt.

Paris possesses a telephonic service; we have above indicated its development.

The order of June 26, 1879, determined the clauses and conditions under which concessions of telephonic lines can be granted.

By the terms of this order, the State reserves to itself the construction of the lines, the cost of which must be reimbursed in full by the concessionaires. The authorisation consists in placing at the disposal of a certain number of subscribers certain wires communicating by means of telephones with a central office in charge of the concessionaire, and by means of which the subscribers can communicate with each other. But it definitely excludes any right on the part of the latter to be placed in direct communication with each other otherwise than through this intermediary.

These authorisations, which may at any time be suspended or withdrawn, are placed under the control of the State, and do not imply any kind of privilege to the profit of the permissionaires. All similar authorisations may be granted by the State.

Although three concessions have been accorded for this object since the month of July, 1879, they have not been, up to the present time, regularly worked.

Further, the telephone is being employed tentatively, at a certain number of secondary offices in the environs of Paris; and telephonic lines subserving private interests have been established by the administration on the demand of private individuals at a great number of points on the territory.

Submarine Cable.

Algeria and France are connected by three cables, starting from Marseille; one of these belongs to the Eastern Telegraph Company, which works it for its own profit.

The other two cables belong to France, and were established, the first in 1871, the second in 1879.

The number of telegrams transmitted in 1878 by the cable of 1871 amounted to 143,942, the charge being 20 centimes per word.

At the period of the laying of the cable of 1879 the charge was lowered from 20 centimes to 10 centimes per word, the minimum cost of a message being also reduced from 2f. to 1fr.

The result of this reduction of 50 per cent. was an increase in the traffic, from the 20th October, 1879, to the 15th April, 1880, over the preceding period corresponding with that stated:—

Of 84,417 despatches, or 104·71 per cent.;
In the number of words, 1,476,037, or 109·72 per cent.;
In the receipts, of 13,087fr. 20c., or 4·86 per cent.

The increase continues, the product of the traffic being:—

In 1878, 610,544fr.;
In 1879, 647,649fr.;
In 1880, it will be 718,760fr.

The Government has demanded the establishment of a third cable in the *projet de loi* of April 29 last.

A submarine cable connecting Antibes with Corsica, and 281 kil. 500 m. in length, was laid in 1878.

On the Atlantic an authorisation was granted, by decree of Jan. 17, 1879, to land at a given point on our coast, one or more transatlantic cables connecting France with North America.

EDISON'S ORE SEPARATOR.

In our "Report" for last week we quoted an American statement to the effect that an apparatus identical with Edison's vaunted ore separator had been in use in that country for some years. It is satisfactory to find that the Americans have themselves found out the ancient character of that latest bantling from Menlo Park. But the same device has been before the world in France for the last twenty years at least in Froment's machine for separating magnetic oxide from copper ore. Froment is the well-known mechanical electrician of Paris, and his apparatus consists of a hopper, through which the ore was poured, and a powerful electro-magnet, which was placed underneath so as to attract the magnetic particles of sand aside from the rest of the nonmagnetic copper ore. The contrivance is, in fact, essentially the same as Edison's. No doubt there are several English patents describing the same arrangement; but Froment's is, as far as we are aware, the first instrument of its kind.

A similar device has been used for some years in America for extracting the bits of wire left in grain from the wire bands of the binding machines so commonly employed by American

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farmers. In fact, magnetism has been applied in the same way to a great variety of purposes.

The ore separator which was to cover Mr. Edison with the wealth of Eldorado, and transform him into a rival of Mr. Mackay, the owner of the "Big Bonanza" mine, is an old affair refurbished up, and though it may make the New York interviewers gape, and tickle the sensation palate of omniverous Yankees, it will, we imagine, hardly pay for its own manipulation in gold extracting. The proportion of "black sand" or magnetic oxide in gold "tailings" is, we are assured by an experienced gold miner, so very small, that its separation from the rest of the ore will make hardly any appreciable difference in the expense of extracting the small percentage of gold from the residue by washing over mercury. Had the black sand formed a considerable proportion of the whole "tailings" there might have been some value in the magnetic separator. As it is the game is not worth the candle.

TELEGRAPHIC GATHERING.

The officers of the old telegraph companies held their annual meeting on Friday last at the Salisbury Hotel, Fleet-street, when about 20 sat down to dinner under the presidency of Mr. Graves, the engineer-in-chief of the Postal Telegraphs, Mr. E. B. Bright, late secretary of the magnetic company, being vice-president. The absence of Messrs. H. Weaver and W. Andrews through illness was much regretted by all. Mr. W. T. Ansell, Mr. T. C. Bennett, Sir Charles Bright, Mr. Muirhead, Mr. G. Newman, Mr. W. H. Preece, Messrs. Ratcliffe, Mr. Sach, Mr. Sanger, Mr. Spagnioletti, and Mr. Lewis Wells were present.

Among the various toasts was one by Mr. Ansell to the memory of the officers of the old companies who are no more; and he made special mention of the death since their last gathering in 1879 of one of the earliest pioneers of telegraphy, Mr. W. H. Hatcher, who died on the 2nd August last.

Mr. Hatcher's name will probably be known to few of our readers, but a few lines in our journal in reference to his career may not be out of place because of his distinguished services in the cause of early telegraphic enterprise. Mr. Hatcher was a native of Salisbury, and matriculated at King's College, London, and became a pupil of several eminent professors—Professor Daniell in Chemistry, Mosley in Physics, Cooper in Construction, and Wheatstone in Experimental Science. He assisted in some of the early experiments in electric telegraphy carried on at King's College, and became the first engineer of the Electric Telegraph Company, and in that capacity laid down the first telegraph line on the Great Western Railway from London to Slough. It will doubtless be remembered by our readers that it was this first experimental line which brought the idea of telegraphic communication prominently before the public notice, for by its agency the murderer, Tawell, was arrested. This first practical illustration of the value of electric telegraphy made its fortune. Mr. Hatcher had the honour of explaining the mechanism and method of telegraphing to Her Majesty and some of the Royal children. He, however, did not long continue the engineer of the Electric Telegraph Company, as he tendered his resignation in consequence of some disputes which arose between the late Sir William Fothergill Cooke and Sir Charles Wheatstone, and as Mr. Hatcher sided with the former, he gave great offence to the scientific party. Mr. Hatcher's subsequent career was passed in the service of Price's Candle Campany, and his death at the comparatively early age of fifty-eight created a gap among a numerous circle of private friends to whom his amiable qualities had attached him. It is to be regretted that Mr. Hatcher's singular modesty restrained him from seeking admission into any of the scientific societies of London, or of publishing many of the discoveries he made, but it is to be hoped that many of the numerous papers left behind him may yet see the light.

EASTERN TELEGRAPH COMPANY (LIMITED).

The sixteenth half-yearly ordinary general meeting of the above company was held on the 15th inst., at the City Terminus Hotel, under the presidency of Mr. John Pender, M.P.

The SECRETARY (Mr. George Draper) read the notice convening the meeting, and the minutes of the last meeting, which were confirmed as correct by the present meeting. The report of the directors, which appeared in *The Electrician* of last week, was taken as read.

The CHAIRMAN, in moving the adoption of the report, stated that the net revenue for the half year ending the 31st March last was £291,194, being an increase of £56,117 over the corresponding period of 1879. Of this sum £4,000 was attributable to telegrams sent by the Cape line, which was opened for traffic on the 29th December last. Their receipts from this source were now at the rate of between £19,000 and £20,000 per annum. This was against the estimate of £15,000 when they proposed the Cape cable to the Eastern Company's shareholders. There was a gain of £2,000 on exchange, although they had lost the Algerian traffic on account of the French Government diverting it on to their own cables, and although their Egyptian traffic showed a decrease, there was a substantial increase throughout the rest of the general system. The remainder was made up of interest, mainly on account of sums advanced in connection with the Eastern and South African Telegraph Company. There was also a sum of £4,850, being a quarter's dividend at the rate of 6 per cent. on their holding of £390,000 in shares of the above company, after having written off £1,000 in reduction of cost. The ordinary expenses of the company amounted to £68,637, being an apparent increase of only £634 over the corresponding half of 1879. The present figures, however, included £1,935 for depreciation of cable stores, against which there was no similar charge in 1879, likewise cost of working forty-three stations, against forty-one in the corresponding period. But for these items, and for exceptional expenses for supplying split pipes for Gibraltar land lines, which cost about £1,000, the ordinary expenditure would have shown a considerable decrease, with an increase of revenue of £56,000. The extraordinary expenses amounted to £19,876, or a decrease of £4,039 over the corresponding period of 1879. This included the expenses of the screw steamer "John Pender" and "Retriever." The former effected repairs in the Red Sea, and the latter, after making various repairs to the Levant cables, proceeded to Gibraltar, and repaired the Gibraltar-Lisbon cable, afterwards proceeding to do further work in the Levant and Dardanelles. This item likewise included expenses of the "Chiltern," amounting to £3,600, while in dock, and also the expenses of the "Great Northern," which on her way to Zanzibar repaired the Eastern Company's cables off the coast of Portugal. They carried to general reserve fund £78,205 on their increased capital, against £16,876 in 1879, making the total reserve of the company £287,569. Some of the outlay now going on in the attempt to recover their duplicate Lisbon-Vigo cable, which very probably would have to be entirely renewed, must be borne by some of the present reserve. Six months ago he went into full details on the position of the company, so that on the present occasion he had very little further to state except this, that their cables were all in good working order, that their staff, so far as efficiency was concerned, was very much improving, and that the saving which they showed in the working of the concern was mainly due to their young men getting better acquainted with the work, to the scientific appliances of which they availed themselves when they offered, so as in every way to reduce the number of hands, to make the hands they had more efficient, and with the view to reduce the expenses of the company generally. He thought they had not been treated properly by the French Government in diverting the Algerian traffic from the company's cable. Notwithstanding the reduction in the Egyptian traffic, Egypt was still a very important station. As to the question of the dividend his own impression was that, until they had a proper reserve fund, they ought to carry forward £100,000 a year, and he believed that when they next met they would be able to show they could do that, and perhaps more. He thought, however, that the shareholders should fully participate in the increased prosperity of the company, always based on making the dividend a permanent 5 per cent. dividend, but that at the end of the year anything over £100,000 to carry forward should go in the shape of bonus to the shareholders. It was the intention of the Board to act on that principle. He then moved the following resolution:—"That the report and accounts of the directors to the 31st March, 1880, submitted to this meeting be, and they are hereby, received and adopted. That a dividend on the preference shares of the company to the 30th June, 1880, at the rate of 6 per cent. per annum be paid less income tax; and that in accordance with the directors' recommendation a dividend be and is now declared of 2s. 6d. per share free of income tax, on the ordinary shares of the company, making, with previous payments by way of dividends on account, a dividend of 5 per cent. on those shares for the year ending 31st March, 1880."

The Marquis of TWEEDDALE seconded the motion.

A discussion followed, to which

The CHAIRMAN fully replied, and the motion was carried with one dissentient. Continuing, he moved the second resolution as follows:—"That the Board of Directors be, and are hereby, authorised to make and carry into effect, and if they think fit from time to time alter and vary arrangements for assisting the *employés* of the company in effecting insurances upon their lives, and for this purpose to pay out of the revenues of the company such sums as they may from time to time deem expedient, not exceeding in any case one half of the premiums required." The policy referred to in the resolution had been adopted by the Anglo-American and the Great Northern Telegraph Companies, to the *employés* of which it had given great satisfaction. It was desirable to have efficient men, and efficient men would go where they were best cared for. They required well-educated and honourable young men, whom they had to send away from home, to climates not always the best to live in, and it was their business and duty to take care of them. The sum which would be required would be only from £2,000 to £2,500 a year—a very small amount compared to the advantage the company would derive in having a well-disposed class of young men in their employ, and they might depend upon it that the more they raised their *employés* in their own estimation, the better they would be served.

Sir JAMES ANDERSON, in seconding the motion, said it was worth while that the shareholders should know that the young men in the employ of the company were doing certain work in sixteen or eighteen hours which twelve months or two years ago they could not have done in the whole twenty four. They had such highly trained young men that they could telegraph to Egypt, and rely on it, in half an hour. He hoped the shareholders would pass the resolution unanimously, and show that they cared for the young men in their employ. Their hope was to make them insure separately for much larger amounts entirely at their own risk.

The CHAIRMAN put the motion, which was at once carried unanimously, at which he expressed great satisfaction. He then moved the following resolution:—"That the purchase on behalf of the company of 19.000 fully-paid shares of £10 each of the Eastern and South African Telegraph Company (Limited), on the terms stated in the report submitted

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to this meeting, be, and the same is hereby, approved and confirmed, and that the board be and are hereby authorised for the purpose of such purchase to provide and apply the sum of £95,000 out of the funds of the company in the manner proposed in such report."

The Right Hon. W. N. MASSEY, M.P., seconded the motion.

A discussion followed as to the policy of acting on the resolution at once, or deferring the purchase for 12 months, and an amendment to that effect was proposed.

The CHAIRMAN replied, and put the amendment, for which only four hands were held up, and the original motion was afterwards passed.

On the motion of Mr. WILLIAM ABBOTT, seconded by Major LESLIE, a cordial vote of thanks was passed to the Chairman and Directors.

The CHAIRMAN, in replying, after expressing the acknowledgements of his colleagues and himself, said that there was not one point of importance that occurred which they did not place before the shareholders, and they did nothing which they were not prepared to justify. Whatever they had done had been in the interests of the company.

The proceedings then terminated.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

Report of the directors for the half year ending 30th June, 1880, to be presented at the eighteenth ordinary general meeting of shareholders to be held on the 21st day of July, 1880.

The directors beg to submit, duly audited, the balance-sheet and accounts for the half year ended 30th June last, from which it will be seen that the gross receipts, including the balance brought from last account, amount to £20,562 4s. 1d., and the gross expenditure to £3,718 3s. 9d., leaving a sum of £16,844 0s. 4d. to the credit of revenue account. Of this the sum of £4,300 has been placed to the reserve fund, increasing that fund to £32,063 13s. 10d. After providing for the preference dividend, a balance of £9,544 0s. 4d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, which will absorb £5,600, and leave £3,944 0s. 4d. to be carried forward to the current half year's account to meet the cost of the repair of the Cienfuegos-Santiago section of the original cable. The directors regret to report that this section, which the shareholders will recollect was repaired in November last, again gave way in March. Mr. Keith, the Company's engineer, is now engaged in the work of repairing it, intelligence of the completion of which may be received at an early date. It will be satisfactory to the shareholders to learn that the Company's other cables continue in good working order.

ABSTRACT OF PATENTS.

4400. ELECTRIC APPARATUS, *W. R. Lake.—Dated 29th October*, 1879.—(*A communication.*) 1*s.*

A dynamo-electric machine is composed of field magnets with their coils wound conically, the wide portion being placed as near as possible to the revolving armature. In combination with these coils are accessory coils wound in the same direction as the former coils, and filling up the spaces between the pole pieces, which are formed so as to leave gaps opposite each other, and as near as practicable to those parts of the cores of the field magnets towards which the armature is moving. The core of the armature consists of pieces of iron of circular or polygonal shape, with projections extending radially outward, upon which separate coils of insulated wire are wound. The flutings are filled in by winding coils completely over the ends of the cylinder. A regulator for the electric light is formed by connecting one of the carbon electrodes to the armature of an electro-magnet, and on the passage of the current the armature is attracted to its magnet, and there held in its position relative thereto, thus effecting the separation of the electrodes. The motion of the other electrode is under the control of a separate electro-magnet, whose coils are in a shunt circuit around—the arc between the electrodes. Means for the accumulation or storage of electrical current producing power are described.

4428. ELECTRICAL APPARATUS, *E. G. Brewer.—Dated 30th October*, 1879. —(*A communication*). 6*d.*

The electro-magnet is hollowed out internally, and into or over it the armature fits.

4456. APPARATUS FOR CONTAINING AND PROTECTING TELEGRAPH WIRES, *J. T. King.—Dated 1st November*, 1879.—(*A communication.*) —(*Not proceeded with.*) 2*d.*

Lengths of metal are rolled, cast, or otherwise formed with grooves or channels to contain the wires, such grooved parts being enamelled with porcelain. These lengths are fitted with covers and coupling pieces, also hannelled to receive cement or other substance, so as to exclude moisture.

4534. ELECTRIC MACHINES, *C. W. Siemens.—Dated 6th November*, 1879. 6*d.*

The resistance of the coils of the stationary magnets of dynamo-electric or electro-dynamic machines is very largely increased so as to be from eight to twelve times that of the armature coils, and instead of arranging the connections for the coils in the usual way, they are arranged so that the increased coils form portions of a branch circuit connected to the external circuit of the machine beyond the commutator.

4555. ELECTRO-MAGNETS, *J. Bell and G. Scarlett.—Dated 8th November*, 1879.—(*Not proceeded with*). 2*d.*

Two or more coils or helices of wire are wound round the same core, or two or more independent wires insulated from each other are wound in the same coils or compound helices.

4572. CONDUCTORS OR CABLES FOR TELEPHONIC PURPOSES, *W. R. Lake.—Dated 10th November*, 1879.—(*A communication.*) 6*d.*

Any number of lines arranged in proximity to each other and following the same general direction are woven in and out among themselves, so that they repeatedly cross and recross at short intervals, each line having an earth connection, and consequently no metallic return wire.

4576. ELECTRIC LAMPS, *T. A. Edison.—Dated 18th November*, 1879. 6*d.*

This relates to improvements upon patent No. 2402, dated 17th June, 1879, and consists in the light giving body of carbon wire, or sheets coiled and arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 14.		Business Done Week Ending July 14. Highest.	Lowest.
Anglo-American Ordinary.x d. 14 July	62⅜,	63½	63	61½
Do. "B" .....x d. 14 July	92¼,	93¼	93⅛	92⅜
Do. "A"	35½,	36½	36⅜	33½
Brazilian	8 11-16,	13-16	8⅞	8 11-16
Cuba	9½,	10	10¼	9⅞
Do. Ten per Cent. Pref.	15½,	16½	16	16
Direct Spanish	1¾,	2¼	—	—
Do. Ten per Cent. Preference	11,	½	—	—
Direct United States	12,	¼	12	11⅜
Eastern.....	9 7-16,	9-16	9 9-16	9½
Do. Six per Cent. Debenture	103,	106	105½	105½
Do. Five per Cent. do. 1899...	105,	108	—	—
Do. Six p Ct. Preference	12⅛,	⅜	12⅜	12⅛
Eastern Extension ..... x d, 14 July	9 7-16,	9-16	9⅝	9½
Do. Six per Cent. Deb.	107,	110	108¾	108¾
German Union	9,	¼	9⅜	9¼
Globe Telegraph & Trust	6½,	⅝	6½	6 1-16
Do. Six p Ct. Preference	12 3-16,	5-16	12¼	12
Great Northern	9⅜,	⅝	9 11-16	9½
Indo-European	23,	24	23½	23½
Mediterranean Extension	2⅜,	3½	3¼	3¼
Do. Eight per Cent. Preference.....	10½,	11	11	11
Reuter's	9¾,	10¼	10½	10
Submarine	247,	252	—	—
West India and Panama	1¼,	⅜	1⅜	1⅜
Do. Six per Cent. 1st Preference...	7,	¼	7	7
Western and Brazilian	6⅛,	⅜	6⅞	6
West. Union 7 p. Ct. 1st Mt.....	120,	125	120	120
Do. Six per Ct. Sterg.	104,	107	—	—

TRAFFIC RECEIPTS FOR JUNE, 1880.

Companies.	June, 1880.	June, 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company.....	—	—	—	—
Cuba Submarine Company.....	2,700 estd.	2,425	275	—
Direct Spanish Telegraph Company	1,277 estd.	1,025	252	—
Direct United States Telegraph Company ...	—	—	—	—
Eastern Telegraph Company	—	—	—	—
Eastern Extension Telegraph Company	29,100	26,485	2,615	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company..	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company.	—	—	—	—

THE "JAMIN" PATENT ELECTRIC LIGHT.
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
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SLIP

JOURNAL OF THE SOCIETY OF TELEGRAPH ENGINEERS.—The current number of this Journal contains several valuable papers by Messrs. Andrews, Hockin, Kempe, Preece, Graves, and Siemens, which should be carefully studied.

ELECTRICITY AT THE THE THEATRE.—Under this heading our contemporary *l'Electricité* gives descriptions and illustration of different forms of apparatus which have been and may be employed in the production of scenic effects—such as the rising sun in *Le Prophète*, the rainbow in *Moïse*, &c. The article is contributed by M. F. Géraldy.

THERMO-ELECTRICITY.—It is stated that a thermo-electric battery has been constructed in America by Professor Langley, with one of its elements constituted by sheets of iron of such extreme tenuity that ten or twelve thousand of them, superposed, do not exceed an inch in thickness. We have, however no details as to the method of construction.

THE ELECTRIC LIGHT IN VIENNA.—The Jablochkoff light is about to make its appearance in the Volksgarten, one of the most popular promenades in Vienna. The largest *café-concert* in the capital is situated in the middle of this promenade, and the proprietor has decided to illuminate it by means of thirty of the *bougies* devised by the above-mentioned inventor.

CITY GUILDS INSTITUTE EXAMINATION.—Mr. H. M. Sayers, of the Central Telegraphs Department, St. Martin's-le-Grand, has been awarded the first prize (£5 and a silver medal) in the honours examination for Technical Telegraphy, instituted by the City and Guilds Technical Institute. Mr. E. G. Pink, of the same department, received the second award in the same examination, after having headed the list of competitors in each of the two preceding years. Mr. Sayers also passed the honours examination of the Science and Art Department in Magnetism and Electricity, last year obtaining five first-class certificates and prizes. Both the successful Students have been studying under Mr. W. Shirgo, the principal of the Central Telegraphs School of Science, who himself holds fifty science and art certificates.

ELECTROLYSIS OF MALONIC ACID, BY E. BOURGOIN (*Compte Rendus*, 90, 608—611).—When an alkaline solution of sodium malonate is electrolysed, the gas evolved at the positive pole consists simply of a mixture of oxygen, carbonic anhydride, and carbonic oxide without any hydrocarbon, whatever the degree of alkalinety or concentration of the solution. With a neutral solution of the salt, carbonic anhydride alone is evolved, and the liquid becomes strongly acid in the positive part of the cell. After a time, the carbonic anhydride is accompanied by carbonic oxide and oxygen. With free malonic acid, the gas consists mainly of oxygen, with small quantities of carbonic anhydride. Malonic acid, then, differs from succinic acid in that no hydro-carbon is produced when it is electrolysed, and it differs from oxalic acid in its greater stability, and in that it concentrates itself in the positive part of the cell.

CONSERVATION OF ENERGY.—Experiments have shown that not only may one kind or form of energy be translated into another but also that in the translation nothing is lost, and that there is every reason to believe that the destruction of energy is, equally with that of matter, impossible. There is throughout the universe nothing but the transformation of energies; no loss of energy is possible. Its disappearance in one form is owing to its change or conversion into another; and had we a machine or engine capable of reversion, like the simple pendulum, for kinetic and potential energy, we might see the oscillation of energy between the two forms of mechanical and heat energy, for example, just as we do that of the pendulum between kinetic and potential. There may be an ebb and flow between the relative amounts of the various energies, but the sum of them is all constant and invariable throughout our universe. There may, indeed, be a tendency of all the present energies of nature ultimately to pass into one uniformly diffused heat-quiver; it may be, indeed, that, in some incalculably remote age, all the changes will have been rung upon the present distribution of the forms of energy, and that the vitality of all nature will exist merely in a universal pulse. Yet the grand generaliastion of modern times constrains us to believe that in that pulse will be found the exact representative of every motion and form of energy at present operating around us, that, in fact, energy is coeternal with matter.

ELECTRIC INDICATOR FOR STEAM BOILERS.—Amongst the countless applications of electricity, the electric boiler-indicator of MM. Lethuiller and Pinel, of Rouen, deserves mention. By means of this apparatus the water level in a boiler may be ascertained at any distance from the latter. The arrangement employed for this purpose consists of an indicating tablet, which may be placed in any part of the establishment, however remote from the boiler house, in the office of the engineer, or the superintendent, or within reach of the boiler inspector. This tablet is connected with the electric indicator, which is fixed at the top of a vertical tube above the boiler, by two electric conducting wires. At the lower part of the scale of the indicator are placed two pieces of copper, upon each of which is fastened a small platinum plate. These platinum wires are superposed at a distance of 0·08 inch. When the index, which is attached to a vertical rod connected to the float in the boiler, descends, it rests on the upper plate of platinum, depresses it, and puts it in contact with the lower plate. An electric current is thereby established from a battery connected with the apparatus, causing a bell on the indicator to ring, while at the same time the sign "low water" appears on the tablet. Similar pieces of copper and platinum are fixed at the upper part of the scale, and when the index reaches this limit in consequence of the rising of the float, the bell rings as before, and the indication "high water" is shown on the tablet. In order to remove the warning words from the tablet, a button is pressed, which returns the indicating parts to their normal position.

EFFECTS OF THE THUNDERSTORM.—Mr. J. Johnstone thus writes to the Edinburgh *Daily Review*:—On the 7th curt., about 4:15 p.m., the lightning struck the craig which is named on the plan of Edinburgh "The Dasses," which overhangs the Hunter's Bog on the east. The results are so extraordinary that they are worthy of notice in your columns. The rock struck is of the hardest basalt, commonly called whinstone. The lightning did not strike the sharp, serrated, front edge of the craig, as might have been expected, but, on the contrary, it struck the flat top covered with sod at a distance of 3 ft. from the present edge, and that must have been between 6 and 8 ft., from the edge before the accident; for the lightning detached several tons of the rock from the front of the craig, and sent six large masses of rock down into the Hunter's Bog, the largest of these measures 4ft. long by 3ft. broad and 1ft. thick, but of irregular shape. On the edge of the craig the lightning detached a mass of rock, which now stands in a very precarious position. This large mass measures 4ft. 9in. long, by 3ft. broad and 1ft. 4in. thick. The top of the craig

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a short distance from the front of it, is covered with a coating of angular pieces of basalt, and on the top of these a covering of sod. It was on the sod the lightning struck, and made a hole 2ft. 6in. long by 1ft. 6in. broad. The largest diameter of the hole is in a direction from N.W. to S.E., and the lightning continued its course in this direction, ploughing a furrow in the sod for a distance of 19 yards, the furrow diminishing in width as it receded from the original hole, where it measures 5in. wide. These facts establish the direction in which the lightning came, and correspond with the observations of three gentlemen who were in a house on the west side of the Hunter's Bog, and saw the lightning pass across the Bog to the rock on the east side, namely from N.W. to S.E. In *The Times* of the 14th of October last notice was given that a committee of scientific gentlemen had been appointed by insurance and other companies to investigate the effects of lightning, with a view to providing the best means for protecting buildings, and a request was made that all persons who could furnish information on this subject were requested to do so. In consequence of this notice I wrote a letter to *The Times* on 25th October, containing the following information, which it is important persons should know who wish to watch thunderstorms, and give the information asked. There are three kinds of thunderstorms. First, those that take place between clouds, the lightning flashing from cloud to cloud; second, storms in which the lightning comes from the clouds down to the earth; third, storms in which the lightning passes from the earth to the clouds. It is the two latter kinds of thunderstorms which affect the question of the protection of buildings. The damage done to them and to trees by lightning varies in a remarkable manner, according to whether the lightning went from the earth to the cloud or from the cloud to the earth. The lightning which struck the Dasses Craig has an important bearing with reference to the protection of buildings from lightning. The common theory is that lightning will always be attracted to and strike the highest or most prominent point in its vicinity. The Dasses Craig is near the bottom of the valley, bounded by Salisbury Craigs on the W. and S., and Arthur's Seat on the E. High land and prominent rocks surrounded this craig on all sides, and yet the lightning passed all these and descended into the valley to strike it. Another interesting fact. On placing a compass near the hole made by the lightning I found that the needle deviated from the N. to the E. and when the compass was in the hole the needle stood at E.S.E., instead of N., proving that the rock is still powerfully electrical at the spot where the lightning struck it. But, except in the vicinity of the hole, the craig does not affect the needle."

The Conductivity of Tourmaline Crystals.—In the *Philosophical Magazine* for July, 1879, Professor Sylvanus Thompson and Dr. Oliver Lodge give the results of some very interesting experiments upon the unilateral conductivity of tourmaline crystals for heat and electricity. Dr. Lodge had shown that an explanation of pyroelectricity might be given if such crystals possessed a unilateral conductivity for electricity. A body is said to possess unilateral conductivity for anything if it conducts better in one direction than in the opposite one—as, for example, a tube with a series of funnels in it all turned the same way for fluids, and apparently, in the case of Geissler's tubes, for electricity also. The result of their experiments was that tourmaline crystals do possess a unilateral conductivity for heat *as long as their temperature is variable*, and similarly for electricity *as long as the temperature varies*. The first of these facts is an important and valuable increase of our knowledge; but the latter, as they point out, is, of course, only due to the already known electromotive force which constitutes their pyroelectric properties. They seem to have been dissatisfied with these results; for they had hoped to discover unilateral electric conductivity independently of changes of temperature. They do not seem to have noticed that what analogy should have led them to look for was unilateral conductivity *during changes of intensity of the current*. It is to be hoped that, as they possess a very fine specimen of tourmaline, they will continue their investigations into this point. In the meanwhile it may be worth noticing a mechanical illustration of how this might be connected with pyroelectricity. Suppose a wire carrying a current, surrounded by a number of magnets, and that a a majority of them pointed in one direction round the wire, and that each was kept in its place by a spring. On passing a current through the wire, all the magnets that did not point round it in a particular direction would tend to set themselves in this direction; and during changes of intensity of the current, work would be done against or by the springs. If the current passed in such a direction that the majority of the magnets were set so as to remain unchanged, there would be less work done by changes of intensity than if the current were in the opposite direction; and this would give rise to an apparent unilateral conductivity. I say "apparent," because the weakening of the current is due to an inverse electromotive force, and not to a true increase of the resistance. The same effect would be produced by supposing a majority of the magnets turned in the same direction along the magnet, and kept in position by two springs, one on each side, but one stronger than the other, when, of course, a current would have to do more work in turning them to one side than to the other, so that in this case also there would be apparent unilateral conductivity during variations of the current. Now, suppose that the proportion of polarised magnets or their strength depended on the temperature of the system. It is then evident that during changes of temperature there would be changes in the numbers or strengths of the polarised magnets; either would produce an electromotive force in the wire during the change. Hence the phenomena of pyroelectricity would be manifested by such a system. I put these forward merely as illustrations, not supposing that the structure of tourmaline is necessarily at all *like* either of them; but there are generally great analogies between different systems exhibiting the same phenomena, and an illustration gives us a concrete stepping-stone to found our conceptions on during the difficult transit to the abstract. The passage of a current through an iron wire is accompanied by the production of a series of magnetic elements round it; and the effect of this has been noticed as causing an apparent change of resistance during changes of the current; but as there is no want of symmetry in the wire there is no apparent unilateral conductivity.—*G. F. FitzGerald in the Proceedings of the Royal Dublin Society.*

"There's Room at the Top."—The following extracts from the *Scientific American* will be read with interest in connection with our leader of last week:—The young man ambitious to succeed in any line of business should always bear this in mind. There are those in plenty of mediocre ability, superficial acquirements, and inadequate preparation, but the thoroughly trained and competent are scarce. The demand for men who have a complete knowledge of every department of their business has always been felt. The extent of that knowledge widens every year as improved methods and facilities are introduced. The ship captain, for instance, who a few years ago needed only to be acquainted with centuries old theories of navigation, with

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what more recent geographical explorations had added thereto, now finds himself in this age of steam working under totally different conditions. What he formerly knew is equally necessary now, but the successful management of a ship propelled by steam calls for an entirely new set of ideas and experiences, and the captain who would at present be a thorough master in his profession should not only know how to run a steam engine, but be a practical hydraulic engineer, with a good knowledge also of pneumatics and electricity, in order to avail himself of all the advantages which recent discoveries and inventions have placed at the disposal of navigators, whereby more efficient work may be done and a higher degree of safety attained. There are captains in plenty who are sailing masters only, but in proportion as they are also competent in these other departments, whereby they become in fact independent of their subordinates, do they attain the higher positions and greater responsibilities of their profession. And what is true in this instance may be said of nearly every branch of business, as we find a like necessity for greater amplitude and thoroughness of preparation in all lines of professional activity. The discoveries in chemistry within a few years past have been of far reaching importance, and many of them have been such that a first-class doctor cannot remain ignorant of the advances made and retain his position in the front rank of his profession. With lawyers, also, a greater familiarity is expected with all departments of modern science, so that many members of the bar at the present day may be really classed as experts in the technicalities of important industries. And with these demands for a higher standard of preparation the facilities for its attainment have been so multiplied that they are easily within the reach of all who have the disposition and the energy to avail themselves of the opportunities offered. . . . . "I have taken all knowledge to be my province," wrote Lord Bacon, in 1592, when he was only thirty-one years of age. The expression often occurs to us when we consider what is now expected from first-class mechanics as well as from professional men. Bacon excelled all other men of his day in a "knowledge of the mutual relations of all departments of knowledge," and his philosophy, more than that of any one else of his time, taught "the art of inventing arts." Taking his meaning in this sense, there are many to-day who might fitly say what Bacon said of himself. But this is pre-eminently a practical age, and, while it shows the best possible development of the Baconian philosophy, it requires, of all who would stand at the head in any department of the world's activity, an amount of practical knowledge of which he had only a general conception. The multitudes which now crowd upon each other in the competitions of life are of those who do not meet the call for that better culture and more complete preparation of which society can never have enough, and which the diversified industries and great enterprises of modern times will always find ample employment for. "There is always room at the top," said Daniel Webster, in reply to the inquiry of a young lawyer as to the chances of success in his profession, and only those who pursue their avocations, of whatever nature, with this in mind, are certain to succeed.

Distributing Currents for Electric Lamps.—Among the many recently-introduced improvements calculated to make electric illumination permanently practicable, says the *Mining Journal*, is one by the Société Générale d'Electricité, of Paris, which is specially worthy of attention; it is a disconnecting and commutating apparatus for distributing currents to the lamps, and is so arranged that if one of a number of lamps or groups of lamps should by accident become extinguished, or should its carbons break or be consumed, this lamp is automatically thrown out of circuit, and the next in order is brought into circuit. When the lamp is of the Jablochkoff kind there is attached to the clamp that holds the candle a strip made of two metals having unequal degrees of expansion. The strip is bent in U form inverted, and is attached by one of its limbs, presenting its bend near the lower end of candle. When the candle is burnt down to this point, the heat of the voltaic arc acting on the bent strip causes it to partially unbend, so that its free limb comes against a contact screw, and thus establishes a circuit of less resistance by which the electricity passes, without continuing to pass through the residuary carbons of the candle. The free end of the bent strip may have attached to it a spring, which is usually held in a bent position by butting against a stop, until by the change of shape of the strip it is released from the stop, whereupon it springs against the contact screw and short circuits the current. The commutator whereby the candles are brought successively into circuit consists of a vessel of ebonite or other non-conducting material, divided into a number of parallel compartments, each containing mercury, connected by wire with one of the lamps or candles. Above this vessel is mounted a shaft which extends over all the compartments; it has on it a metallic disc which dips into the mercury of the first compartment, and at intervals along it, corresponding to the distance of each compartment from the next, it has a number of metallic pins projecting from it, these pins being arranged helically on the shaft, so that when the shaft is turned round, as one pin is leaving the mercury in one of the compartments the next pin in order is entering the mercury in the next compartment. On the shaft is an escapement wheel, which is worked by an anchor on the armature of an electro-magnet. The armature of a second electro-magnet is attached to a lever, which carries at its end two metal pins immediately over two cups containing mercury. Usually while one lamp of a series is in action the electric current for the lamp passes through the coil of this second electro-magnet, which by attracting its armature, keeps the metal pins out of the mercury. When, however, from any cause the lamp becomes extinguished, the second electro-magnet, no longer excited by an electric current passing through its coil, ceases to attract its armature; the armature lever thereupon moves so that its pins dip into the mercury cups, giving passage for the electric current to the first electro-magnet, the armature of which, moving the anchor, turns the escapement wheel and its shaft partly round. By this movement of the shaft the one of its pins which was in the mercury of one compartment, closing the circuit of the lamp that was in action, is withdrawn from the mercury, so that this lamp becomes excluded from the circuit, and the next pin on the shaft being now immersed in the mercury of the next compartment, closes the circuit for the next lamp in order. Immediately on that lamp coming into action the electric current again passes through the coil of the second electro-magnet, which, attracting its armature, withdraws the pins thereof from the mercury cups in which they were immersed, and so causes the first electro-magnet to be excluded from the circuit until it is again brought into circuit by the extinction of the active lamp or candle. Thus, as lamp after lamp ceases to act fresh lamps are brought successively into circuit. It is convenient to number these lamps consecutively, and to fix on the shaft an index which, as it is moved by the shaft over a dial marked with numbers corresponding to those of the lamps, indicates at any time which of the lamps is in action.

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A PRELIMINARY ACCOUNT OF THE REDUCTION OF OBSERVATIONS ON STRAINED MATERIAL, LEYDEN JARS, AND VOLTAMETERS.*

BY JOHN PERRY AND W. E. AYRTON.

(CONCLUDED FROM P. 101.)

Charging with one Minotto's Cell of a Voltameter containing Distilled Water well freed from Gas, and the platinum spirals heated red hot *in vacuo*.

August, 1876.

Time in minutes.	Observed current u.	u' calculated from the formula.	Difference $(u-u')$.
1·5	200	164·2	35·8
2	187·4	161·9	25·5
3	173·7	157·3	16·4
4	163·9	153·1	10·8
5	156·0	148·9	7·1
6	149·3	145·1	4·2
7	143·5	141·6	1·9
8	138·8	138·2	0·6
9	134·9	136·0	−1·1
10	131·7	132·1	−0·4
11	129·0	129·3	−0·3
12	126·5	126·7	−0·2
13	124·0	124·3	−0·3
14	121·7	121·9	−0·2
15	119·7	119·8	−0·1
16	117·8	117·8	0·0
17	115·9	115·9	0·0
18	114·0	114·0	0·0
19	112·4	112·4	−0·1
20	11·97	110·8	−0·1
21	109·2	109·3	−0·1
22	107·8	107·9	−0·1
23	106·5	106·6	−0·1
24	105·3	105·3	0·0
25	104·2	104·2	0·0

Discharge of the same Voltameter after being charged with one Minotto's Cell for 1 hour and $7\frac{1}{3}$ minutes.

Time in minutes from the moment of discharging.	Observed current u.	u' calculated from the formula.	Difference $(u-u')$.
0 before discharge	286·0		
0·5 after discharge	79·5	30·1	49·4
1	60·8	29·2	31·6
2	41·0	27·7	13·3
3	32·8	26·2	6·6
4	28·0	24·8	3·2
5	24·7	23·4	1·3
6	22·5	22·2	0·3
7	20·5	21·0	−0·5
8	19·4	19·9	−0·5
9	18·2	18·8	−0·6
10	17·0	17·8	−0·8
11	16·5	16·8	−0·3
12	15·9	15·9	0·0
13	15·1	15·1	0·0
14	14·3	14·3	0·0
15	13·5	13·5	0·0
16	12·8	12·8	0·0
17	12·1	12·1	0·0
18	11·4	11·4	0·0
19	10·8	10·8	0·0
20	10·2	10·2	0·0
21	9·7	9·7	0·0
22	9·2	9·2	0·0
23	8·7	8·7	0·0
24	8·2	8·2	0·0
25	7·8	7·8	0·0

If the platinums after absorbing gas were merely kept for a long time in the vacuous space above the distilled water, but not *heated* to assist the driving out of the gas, then after raising the water to surround the wires, the charge current as observed on applying the Minotto's cell is given under u in the following table; while u' is calculated from

$$u' = 96{\cdot}3 + 79{\cdot}43\,\epsilon^{-0{\cdot}64\,t},$$

which is the solution of the differential equation, and which represents the charging phenomena almost from the moment of applying the Minotto's cell.

* Read before the Royal Society, May 27.

Charging; Gas-freed Distilled Water, Platinum Spirals not heated.

August, 1876.

Time in minutes.	Observed current u.	u' calculated from the formula.	Difference $(u\ u')$.
0·5	165·0	153·9	11·1
1	138·5	138·1	0·4
2	118·0	118·3	−0·3
3	107·5	107·9	−0·4
4	102·4	102·4	0·0
5	99·5	99·5	0·0
6	98·0	98·0	0·0
7	97·2	97·2	0·0
8	96·7	96·7	0·0
9	96·5	96·5	0·0

When the distilled water and the platinum spirals were thoroughly aerated, the charging current measured experimentally is shown under u in the following table; while u_1 is calculated from

$$u' = 40{\cdot}25 + 101{\cdot}25\,\epsilon^{-0{\cdot}087\,t}.$$

Charging with one Minotto's Cell, Distilled Water and Platinum Spirals thoroughly aerated.

August, 1876.

Time in minutes.	Observed current u.	u' calculated from the formula.	Difference $(u-u')$.
1·5	144·0	129·3	14·7
2	134·4	125·5	8·9
3	120·9	118·3	2·6
4	111·7	111·8	−0·1
5	105·0	105·8	−0·8
6	99·7	100·3	−0·6
7	95·3	95·3	0
8	90·7	90·7	0
9	86·5	86·5	0
10	82·6	82·6	0
11	79·1	79·1	0
12	75·8	75·8	0
13	72·8	72·8	0
14	70·1	70·1	0
15	67·6	67·6	0
16	65·3	65·3	0
17	63·2	63·2	0
18	61·3	61·3	0
19	59·1	59·1	0
20	57·9	57·9	0
21	55·4	55·4	0
22	55·1	55·1	0
23	53·8	53·8	0
24	52·7	52·7	0
25	51·7	51·7	0

When the distilled water and the platinum spirals were thoroughly freed from air, and subsequently saturated with hydrogen, the charging current measured experimentally is given under u in the following table; and u' is calculated from

$$u' = 120 + 38{\cdot}02\,\epsilon^{-0{\cdot}125\,t}.$$

Charging with one Minotto's Cell, Distilled Water, and Platinum Spirals, thoroughly freed from Air, and then saturated with Hydrogen.

August, 1876.

Time in minutes.	Observed current u.	u' calculated from the formula.	Difference $(u-u')$.
1·35	196·0	152·1	43·9
2	170·5	149·6	20·9
3	155·8	146·1	9·7
4	148·0	143·0	5·0
5	142·5	140·3	2·2
6	138·5	137·9	0·6
7	135·5	135·8	−0·3
8	133·5	134·0	−0·5
9	132·2	132·3	−0·1
10	130·9	130·9	0
11	129·6	129·6	0
12	128·5	128·5	0
13	127·5	127·5	0
14	126·6	126·6	0
15	125·8	125·8	0
16	125·1	125·1	0
17	124·5	124·5	0
18	120·0	124·0	0
19	123·5	123·5	0
20	123·1	123·1	0

The equations, therefore, which we have obtained, as solutions of the general differential equation, to represent the phenomena

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of *charging* our voltameter with one Minotto's cell, when the distilled water and the platinum spirals were in different states as regards the gas absorbed are :—

I. Distilled water freed from gas, platinum spirals left for some time in the vacuum above the water, but not heated—

$$u' = 96{\cdot}3 + 79{\cdot}43\,\epsilon^{-0{\cdot}64t}.$$

II. Distilled water freed from gas, spirals made red hot *in vacuo*—

$$u' = 86{\cdot}2 + 85{\cdot}7\,\epsilon^{-0{\cdot}06245\,t}.$$

III. Distilled water, and platinum spirals thoroughly aerated—

$$u' = 40{\cdot}25 + 101{\cdot}25\,\epsilon^{-0{\cdot}087\,t}.$$

IV. Distilled water, and platinum spirals thoroughly freed from air, and then saturated with hydrogen—

$$u' = 120 - 38{\cdot}02\,\epsilon^{-0{\cdot}125\,t}.$$

These equations, as has been seen, give with considerable accuracy the actual value of the current flowing into the voltameter at any moment during the greater period of the charging in the different cases. The difference between the curves of charge in the different cases is partly due to the different state of the distilled water and the platinums, and partly to the level of the mercury on which the water rested being slightly different in the different cases. To remove the possibility of this latter cause of variation in the curves, the construction of the voltameter was altered, so that the level of the mercury under the water was always so far away from the bottom of the platinum spirals that any slight alteration in the level did not at all affect the curve of charging or discharging. We refrain, however, in this preliminary note from giving any of the reductions of the curves we have experimentally obtained with this improved form of voltameter.

We may remark that the methods usually taken for measuring the resistance of liquids are quite misleading if there is any analogy between voltameters and condensers with solid dielectrics. For instance, on our assumption, the constant terms in the above expressions for u, measuring, as they do, the current after a great time has elapsed, really represent the ratio of the electromotive force of the battery to the total resistance of the voltameter and connections, and therefore their reciprocals are measures of the several resistances. We need hardly mention that in ordinary experiments the current is measured for as short a time as possible, "to avoid polarisation," as it is said. For small values of the time the current flowing into a voltameter, or liquid condenser, is very great, and in our opinion may be regarded as nearly infinitely great; for the first rapid rush of electricity is due to charging the voltameter as a condenser is charged; and if this rush is not quite instantaneous, it is because the electromotive force charging the voltameter does not immediately reach its constant value. But just as the potential of the end of a cable suddenly attached to a battery will acquire its maximum value more and more rapidly as the resistance of the battery and connections is made less and less, so by making the resistance of our single element used to charge the voltameter less and less, and by measuring the time integral of the current flowing in for shorter and shorter periods of time, that is, by using galvanometer needles of more and more quickness of vibration, a better and better approximation to the *static capacity* of a voltameter is arrived at. And we found that when we had reduced the resistance of our single cell to 0·04 of an ohm, by using in this single cell a zinc plate having 15 square feet in area, the more and more carefully we made the experiments, the more and more nearly did the first discharge of a voltameter, which is always less than the first charge, become equal to it. If the charge and discharge in voltameters do not prove to be as nearly equal as in glass Leyden jars, it is because the true conduction current is so much greater proportionally in water than in glass. In certain experiments, which we hope to have the honour of describing fully in a future paper, we have been able to make an approximation to the time integral of this *conduction current* during the small times of first charge and discharge, and by subtracting it from the measured charge, or adding it to the measured discharge, we have obtained what we may reasonably call the true induction charge in a voltameter. We mention this now since, although years ago Mr. Cromwell Varley referred to the electrostatic capacity of voltameters, the investigation of this instantaneous charge has been neglected, because this charge is small compared with the residual one, just as the important investigation of the residual charge in Leyden jars was for a long time not carried out, because the residual charge was small compared with the instantaneous charge.

For assistance rendered in the carrying out of the series of experiments, the results of a few only of which are given in this preliminary account, we have to thank the following of our students :—Messrs. Fujioka, Igarashi, Iida, Inoguchi, Kasai, Kawaguchi, Mita, Nobechi, Oshima.

ELECTRICITY AND AGRICULTURE.

BY PAGET HIGGS, LL.D.

M. L. Grandean, professor in the School of Forestry of France, was the first to point out definitely the influence of atmospheric electricity on the nutrition of vegetation. His labours are described in the "Annales de Chimie et de Physique" for February, 1879, and he there gives the results of experiments carried out in 1876-8. These experiments are little known, but are of the highest importance to agriculture. As they bear upon similar experiments undertaken by the writer, a *resumé* is merited. M. Grandean was led, from the common observation that the underwood in a dense forest disappears, to consider the influence of trees on the vegetation beneath them. Studying the causes generally assigned in explanation of this natural phenomenon, such as diminution of light, influence of the green light reflected by the trees, these appeared to him insufficient, and he deduced that the loss of electricity due to the trees acting as an electrical screen was the cause of the retarded growth, a theory that his experiments, as well as those of M. Mascart, ultimately confirmed.

The experiments consisted in placing plants under similar conditions of soil, light, and water, but covering one plant with a cage of iron wire netting of very large mesh, the netting acting as a Faradaic cage, or somewhat as a lightning conductor. The wires of the netting were one-fiftieth of an inch in diameter, and the mesh 6in. by 4in.

Illustrative of the effect of this arrangement, the case may be cited of two tobacco plants, otherwise under similar conditions :—

	Without Cage.	Under Cage.
Total weight	1·05 metre ...	0·69
Number of leaves	14	10
Weight of fresh leaves.....	107 grammes	70

Chemical analysis showed defective nutrition in the plant placed under the cage, and withdrawn from electric influence. The results are summed up by M. Grandean as follows :—

That trees withdraw for their own profit electricity from the atmosphere, and insulate, as completely as a metallic cage, the plants they cover. Insulation produced by a high tree can extend to the extreme limits of its foliage. A plant withdrawn from the influence of atmospheric electricity is subject to marked retardation in its development, so that the quantity of living substance in insulated vegetation is from thirty to fifty per cent. less than the production in free air.

The transformation of chlorophyllic protoplasm into glucose, &c., appears particularly influenced by atmospheric electricity.

Flowering and fruit-bearing are subject equally to modification. Electricity does not appear to favour the direct combination of the nitrogen of the air with oxygen, nor with the hydro-carbon of the soil; but it exercises a remarkable influence on the nitrification of the nitrogenised matters of the soil, by the intervention of the plant as an electrical conductor. Atmospheric electricity is thus a principal factor in vegetable production.

These considerations induced the writer to carry out a series of experiments to ascertain the effect on vegetable development of a surcharge of electricity. It would appear from the primary consideration of intensified electrical conditions existing in tropical climates that the more rapid growth of tropical vegetation might be due to higher electrical force. To the resident in tropical climes such a proposition would be beyond the limits of theory because of the constant observation of the great development in vegetation during and immediately after a thunderstorm. The experiments undertaken by the writer gave results that leave no doubt that the growth of vegetation may be enhanced 25 to 50 per cent. by the judicious application of electricity. These experiments consisted in placing upon two marble slabs, one of which was carefully insulated, ten plants of the kind under trial. On the insulated slab was raised an iron structure, with depending points arranged to discharge into the atmosphere surrounding the plants, the electricity produced by an induction machine at an estimated potential of about 4,000 to 5,000 volts. This arrangement and difference of electrical condition, other conditions being the same, were maintained day and night for eight months, resulting in unmistakable increase in the development of the uncharged plants.

The practical application of electricity to the hastening of the development of vegetation is easy. Above the plants or amongst them must be placed a *chevaux des frise* of metallic points on a framework insulated from the earth. Wires, carried by small balloons, india rubber, or collodion bladders, filled with gas to a considerable elevation, would collect sufficient of the electricity of the atmosphere, which would be imparted to the points, and these would discharge slowly to the earth, saturating highly with electricity the atmosphere in the neighbourhood of the plants. The cost of such an arrangement would be small, and that great advantages are to be expected from it is undoubted.

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AN ELECTRICAL AGE.

The eminent Electrician who lately designated this "The Electrical Age" could adduce something more tangible than his own enthusiasm to make good the description. In the classic sense of the term indeed the present age is a long way short of its maturity; and we may safely predict of posterity that, following the example of their modern ancestors who have parcelled off The Dark Ages, The Age of Chivalry, and The Renaissance, they will not signalize the present for its achievements in one particular field of scientific activity. Still, in a quite admissible though narrower sense this is an Electrical age, or promises soon to become one. In the province of telegraphy alone the application of electricity has promoted commercial and political prosperity to an extent comparable even with that conferred by the introduction of steam-power. And if the sanguine expectations of men now engaged in adapting electricity to some hitherto unheard-of uses may be trusted, its service in the Arts, and even for mechanical industry will hardly be less conspicuous. It threatens to extinguish gas, and it hopes to outstrip the steam-engine. Nor should the accomplishment of these feats be treated as the mere substitution of one good method for another good method, much less as the barren rivalry of competing selfishness. The gain to mankind in purity, in cleanliness, and consequently in health, could the dreams of the electrician be realized, are obvious to the commonest understanding, and it is greatly on this account that the world regards the new electrical *renaissance* with such encouraging eyes.

Over and above its familiar and now almost commonplace functions in telegraphy, and its yet unfolded capabilities as an illuminating and mechanical agency, however, a glamour of wonderment has been evoked by the more recent discoveries of electrical science—discoveries fascinating alike the unlearned by their magical effects, and the learned by their mysterious promises. The secret of more than one inexplicable phenomena has been all but revealed by those twin prodigies, the Telephone and Microphone; and the clue which they and cognate appliances have afforded for ascertaining the true nature of electricity is hardly less valuable than are the amazing performances of the instruments themselves. If electricity has not yet told us what it really is, its reticence is gradually breaking down, and it has already admitted its kinship with things—may we call them things?—concerning which we are tolerably well informed. Admiration in this instance is not lessened by closer acquaintance. If we are no longer permitted to call electricity either a force or a fluid we can say of it with greater certainty than ever that it is on the one hand as subtle, and on the other as powerful as any fluid or force yet known to us. The air is not more elastic, the volcano not more fierce; the limit of its strength surpasses our capacity to measure it, and its delicacy defies our nicest art to follow it. Had marvels a prescriptive right to stamp themselves upon their age the future would assuredly identify this as the electrical.

Casting our glance backwards over the experimental researches of a whole century, we are at first surprised that the rate at which discovery has progressed, by leaps and bounds at long intervals, has been so very slow. Something of this may be accounted for by the common explanation that invention is often far ahead of contemporary needs. Electric telegraphy had to wait the development of railways, and electric lighting had plainly no chance until gas had made a good light of some kind indispensable. But the chief reason for the erratic and uncertain advance of electrical science is to be found in the manifold sources from which electricity has been derived—or more strictly in the variety of means by which it can be obtained. Friction, chemical action, magnetism, heat, have each had their period of absorbing and almost exclusive interest; and each in turn has more or less delayed the final choice. Upon the whole, however, these hindrances have not to be regretted. The Secretary of State, who told Francis Ronalds in 1816 that telegraphs of any kind were "wholly unnecessary," was quite unconsciously a greater benefactor than the precocious inventor would have been had he found a more tractable official at the Admiralty. Time has allowed us to estimate justly the value of the agencies at our disposal—what they can do for us, and what they are each best fitted to do. Out of these processes of selection and evolution the magnet has come most prominently forward; and the very latest notion is, we learn, to supersede by means of electricity derived from that agent the power hitherto obtained from the voltaic cell. At any rate, modern science has found in the ancient loadstone a supply of electricity which is at once inexhaustible in quantity and infinite in sensibility. It will waft the tenderest whisper, or fuse the stubbornest metal; and in all probability the terrific flame exhibited the other evening in Dr. Siemens's electrical furnace was just as sensitive, say, to the human voice as the diaphragm of Bell's wee telephone.

For the grander of these operations, however, a supplementary force is necessary—a force which is not electrical;

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and it detracts a good deal from the impressiveness of the spectacle when we remember that the Dynamo Electrical machine owes its sublime activity to a vulgar steam-engine in the background. Were the stoker permitted to intrude into the sacred precincts of science we very much fear he might hint that his fire alone would do the whole business quite as well. Artemus Ward's "Perpeteual Moshun Masheen" had only one nigger to turn the handle. If we could but do without him the thing would be perfect. That steam-engine is the inevitable nigger. What he cost in the market, what is his pay, how much he eats, are points upon which we are entirely at the mercy of the showman. If Dr. Siemens can ever induce the public to revert again to the water powers which everywhere float away in despised and not unpolluted idleness, posterity and the heavens which once were blue will thank him. This however seems too good to be realised; and his experiments in horticulture seem too daring to be so. Much has been learnt by watching the unaided operations of nature; but we do not remember any good coming of trying to reverse them, whilst something is always lost by seeking to outwit them. Forced fruits commend themselves to expensive tastes but not to the discriminating; something is wanting, and in the case of electrified strawberries that something appears to be "sugar." Sweetness and light in the material as in the intellectual world go together it would seem only when the light is of the right sort, in due season, and not too much of it.

In respect to the essential properties of the electric light, Dr. Siemens's promised experiments will attract a deeper interest as possibly revealing more than we know already about sunlight. Imagination, indeed, runs riot at the prospect. Suppose the sun should prove to be a colossal electric light, and all other lights of the kind but second-hand copies?—that the identity of electricity and light is closer even than we now suspect? What if the vitality which vegetation owes to the solar rays should be due to that which in mundane parlance we have called electricity? With such revelations we could then comprehend the presence and the origin of that potential energy which is discoverable in every object around us, and the enigma of terrestrial magnetism need no more exercise our good temper. But here we must pause; the practical wants of mankind are pressing to be satisfied; and with the electric light still flickering for existence, and the electric motor little more than an ingenious toy, we cannot afford to linger by a picture which perhaps only a far distant future can unveil.

CORRESPONDENCE.

GALVANOMETERS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: While reading the article on the Deprez galvanometer in *The Electrician* of June 5th, received a few days ago, my attention was engaged by the following paragraph, which I quote for the purpose of making a few comments, which I hope will not encroach too heavily on your space:—"If the current from a powerful battery be passed through the coils of a large electro-magnet, and studied by means of this galvanometer, the intensity of the current may be seen to vary and to increase during a considerable period of time, which under special conditions may extend to a minute, that is to say, the production of the magnetic effect is not completed until the end of this period, during the whole of which the inductive reaction of the electro-magnet is appreciable and continuously decreasing. This remarkable phenomena, discovered, so to speak, *en passant*, by M. Marcel Deprez, shows what services may be rendered by the instrument we have described."

We see from this quotation that the Deprez galvanometer shows an inductive effect of the magnet on the coils during the first periods of time the current is passing through the coils. It must be, therefore, that during magnetisation there is a motion of the lines of force in such a direction as to tend to the production of an opposing electromotive force when the coils cut them as they pass by. On the other hand, the second series of researches of Lord Elphinstone and C. W. Vincent, F.R.S.E., demonstrates plainly that the electromotive force produced in the helices by demagnetisation of electro-magnets is in the same direction as the original current; whence, it appears that in this case the motion of lines of force must be contrary in direction to that in M. Deprez's experiment.

Now, these two experiments just noted may seem to have no apparent connection with each other; but I will endeavour to show that they become interestingly related as a foundation of actual proof to one of Faraday's most beautiful conceptions of lines of magnetic force. Faraday, it is known, imagined lines of force to spring out around conductors and expand concentrically around them as centres, just as the ripples produced by a pebble falling in the water; and that they increased outwards, as new lines originated at the centre, until this outside tension balanced the producing current in the conductor; that when the current was interrupted these lines shortened upon themselves or contracted back towards the centre. But this explanation of Faraday has not gone far beyond the hypothetical state in the opinion of many scientists, especially those whose confidence still lingers in Ampère's doctrines, because a palpable demonstration of the theory has been lacking. With isolated linear conductors, or with helices, the experimental observation of this motion of lines of force has always been totally unsatisfactory, on account of its extremely short duration under those circumstances; but when we call to our assistance a paramagnetic body like iron, as in electro-magnets, then we have a retardation in the process, due to the coercive force of the iron—a magnetic inertia which consumes time and delays the action sufficiently to permit its observation. Therefore, investigation with magnets would seem to be more promising than with currents alone. About a year and a half ago, while studying the effects of armatures of various kinds on the distribution of the force in U magnets, I detected an unmistakable motion of lines of force, which I subsequently investigated and verified fully. I found that on approaching an armature to the poles of the magnet, those lines which cross to the other pole at points on the sides (supposing the poles turned upwards) followed the substance of the magnet upward further, and crossed to the other arm at a point much nearer the poles, and thus crept up, nearer and nearer the poles, until the armature arrived at contact. With the recession of the armature from the poles, the lines fell down the sides from the poles and crossed over at lower points until their original place was resumed. It may be said here incidentally that these motions of the lines of force can account satisfactorily for the currents produced by motions of the armatures of electro-magnets observed by Lord Elphinstone and Professor Vincent.

From these observations, and from other facts which I had previously studied out, I concluded that when a magnet is demagnetising, the lines of force fall down the sides (in U magnets) and contract to the base. When the first paper of Lord Elphinstone and Professor Vincent was received in America, I saw the application of this theory as an explaining factor, and in a letter (December 15th, 1879) to an eminent American scientist, I mentioned it as an argument bearing on a discussion then open between us. A partial quotation will be of interest in this connection. "As to the reason why the magnetic force disappears so rapidly without the armature, my opinion is this—when the armature is removed sufficiently away to overcome the existing tension, by breaking the circuit, the lines of force rebound back in the manner explained in my paper, and undergo a reconstructive process—*i.e.*, the lines of force which went up to the end of one pole through the armature down the other pole now spring out from all points, and endeavour by a circuitous route to re-establish circular connection, and then takes place that *passive* action of shortening which has so often been mistaken for the *active* process, precisely in the same manner that the magnetic field around a linear conductor disappears on breaking the current. The reason why the (ethereal?) medium does not perform the same function as the armature is that, being *diamagnetic*, it possesses no coercive power at all; and instead of gathering the lines of force together, tends to part them, or make them self-repellent, while *paramagnetic* substances like iron concentrate lines of force. As a practical fact it is notable that the size and surface contact of an armature modify considerably its keeping powers on a permanent U magnet."

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If such is the *passive* motion of lines force then, need we say that their *active* movement (*i.e.*, during magnetisation) must be in the reverse direction? Faraday's principles indicate it; my own observations show it; and if that did not suffice, then we could add that the experiment of M. Marcel Deprez *proves* it, for it is only a motion of the lines of force towards the poles that could induce the eleectromotive force in the direction shown by his galvanometer.

In the light of these facts there seems to be no plausible reason to doubt that in a simple helix or bar electro-magnet, the "extra" current due to making the circuit is caused by expansion of the "field" from the centre towards the ends, whereby an opposing electromotive force is induced from these lines being cut by the outer coils of the helix as they pass by; and that the "extra" current due to breaking contact is caused by the passive shortening of the lines of force, by whose reverse motion the induced electromotive force now appears in the same direction as the producing current.

But with an electro-magnet of the U variety, this process of motion is interestingly modified, owing to this fact: The U magnet is theoretically the same as a single bar magnet, with the coil pulled apart in the middle to allow the rod being bent; practically, it makes no difference whether the coils be made continuous or not. Now, if when the magnet is straight the motion is from the centre to the end, then when this magnet is bent into the U form the lines must move *together* towards the poles, and not in relatively opposite directions on each arm. This can be well illustrated by the pebble experiment. When a pebble is dropped in the centre of a dish of water the waves expand out in all directions, and on any two radii placed in a straight line the motion will be relatively opposite; but if we bring these radii almost in contact with each other the motion on both is in the same relative direction, and if we drop the pebble at one end of a narrow trough the motion appears as transverse waves all going in the same direction (on each side of the trough) towards the other end. When the current is sent through the coils of the U magnet the motion of the lines begins, not at the centre of each helix, as in bar magnets, but at points approximately near the lower side of each helix, thence sweeps upwards, producing as the lines pass the helix the electromotive force which reacts upon the current in the manner indicated by the Deprez galvanometer.

These electromotive forces can be expressed mathematically; but such interesting details cannot be well considered in this article, which has already extended itself beyond its intended limits, and, consequently, they must be passed over in silence, to await better opportunities. In the above lines I have endeavoured to reduce a few isolated facts to mutual explanation, and to assimilate them to the pre-existing theory. I believe it will be considered no disparagement of the merits of M. Marcel Deprez, Lord Elphinstone, or C. W. Vincent, F.R.S.E., by those who follow Faraday's mode of looking upon magnetic phenomena, to say that some of these facts, claimed as their discoveries, could be regarded as legitimate offsprings of Faraday's theory; in short, that this is but another instance where the great experimenter has traced the outlines, leaving us to work in the details. Hoping that these notes may elicit contributions to this important branch of science from among the scientific readers of your interesting paper.—Yours, &c., C. ODILON MAILLOUX.

35, Market-street, Lowell, Mass., U.S.A., June 30, 1880.

THEORY ON THE ACTION OF MICROPHONES AS RECEIVERS.

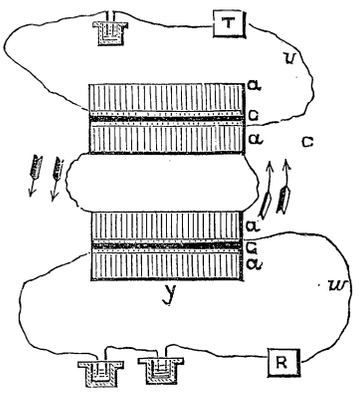
TO THE EDITOR OF THE ELECTRICIAN.

SIR: In a recent description of a new telephonic receiver invented by Mr. Preece (see *Nature* and *Electrical Review*) the opinion has been expressed that the true cause of the receiving effect in microphones was thermo-electric expansion and contraction. Since I discovered (April 8, 1877) that a contact telephone transmitter could act as a receiver also, I have made many experiments to determine the cause, for the purpose of increasing the loudness of such instruments, and have on my part come to the conclusion that the receiving action is almost entirely due to electro-molecular vibration, and only in a very small part to repulsion at the contact and thermal expansion. Permit me to cite the following to support this view:—

I made a circuit of a battery of two Grenet cells, a Reiss transmitter, and for receiver, a plate of carbon 4 × 6 inches, and ¼ inch thick. When pressing the carbon plate against the ear and closing the circuit on the back of the plate by a metal screw or pin, attached to the circuit-closing wire, and held firmly—but in loose contact with the plate—against the latter opposite the ear, the sounds transmitted were loudly reproduced. When using a microphone transmitter in place of the Reiss, articulation was very distinct though not so loud.

Carbon of such thickness being a poor conductor of heat, it cannot well be argued that thermal expansion produced the effect.

Still more striking is the experiment No. 3, published by me in a memorandum, September, 1877. In the experiment which caused the publication,



T is a battery transmitter placed in the primary of an inductorium with one cell of battery.

R is a microphone receiver consisting of a two-inch diaphragm of taggers iron, No. 36. A round pointed iron screw was made to loosely touch the oxidised surface of the iron diaphragm in the centre, the whole being enclosed, clamped and provided with an earpiece in the customary manner. This receiver was placed with 2 cells Grenet battery in the primary of another inductorium, and the secondaries of both were connected to the line, thereby forming a single circuit. The following facts were demonstrated:—

1. When interrupting the circuit V, a loud tick was heard from the receiver R.

2. When leaving out the battery in the circuit W, the tick was greatly diminished in loudness.

3. When the receiver R was placed in the secondary (line) circuit the tick was exceedingly faint.

4. Sound transmitter at T was heard at R in a loudness proportionate to a considerable extent to the strength of the battery in the *receiving* circuit W.

This battery remaining unaltered during each experiment 1 and 2 the contact in the instrument R was of course constantly heated, but what effect could the currents induced by circuit V have on the temperature of this contact.

The mere presence of a battery in the circuit W tended to increase the loudness of the reproduced sound in R which bears some analogy to the fact that a polarised electro-magnet is more sensitive than a non-polarised, and that in a Bell telephone its capacity as a receiver is to a great extent proportionate to the strength of the magnet employed.

The receiving action of microphones being due to resistance at the contact, the molecular motion resulting therefrom is probably due to a recoil of the electric current all along the line of transmission.

The above experiments were made and repeated before prominent electricians, at one time before the late Professor Henry in Washington.—Yours, &c., E. BERLINER.

CARBONS AND DIFFUSING APPARATUS FOR THE ELECTRIC LIGHT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I beg to begin this, probably my last, letter on this subject by thanking your correspondent, Mr. Johnson, for the information he has kindly conveyed to me, and probably to many others, by his letter to you regarding Mr. Pulvermacher's reflectors. I very seldom take the trouble to go to the patent office, for there so many old friends under new faces are to be seen that it is hardly worth the while of anyone to go up two flights of stairs to have a look at them; I am bound to say, though, that Mr. Pulvermacher's patent records a new departure in the manufacture of reflectors for the electric light, and that my humble opinion of his proposals is decidedly favourable; but it is a pity he has not taken more spirited steps to get his reflectors tested.

As far as I am concerned, I have no patent, and therefore I am not advocating my own interest; I am merely and simply advancing my own views on the subject, hoping they may be conducive to the development of electric lighting. I had these same ideas when, two years ago, I proposed to light the British Museum from outside by reflection and diffusion, and I cannot help thinking that if they had been carried out, the ultimate result would have been more satisfactory than it is now.

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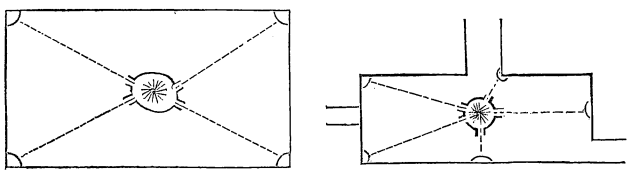
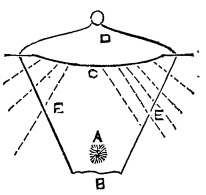
I had a striking example of the value of reflection and proper diffusion one day last week from the place I am writing now. Messrs. Siemens and Co. were then experimenting with what I guess was a marine electric lamp, and it happened that the rays of light for fully five minutes were striking against the walls of a small cottage overlooking the gardens of the houses on my side of this street; these walls have lately been whitewashed, and the result of that was that my garden and that of my neighbour were beautifully illuminated for the time. Now, I am fully one mile and three-quarters from the Messrs. Siemens' works. Now, to proceed with my subject. In my last letter it would appear from my description of the screen I should use to hide my focus of light that such screen would be impervious to light, except through the three or more holes I should have in it; whereas, what I wanted to say was that the *naked* light only would pass through the holes, whilst the other parts would allow only diffused rays to penetrate, in other words the screen would be semi-transparent. With this correction recorded I proceed to light a square, in which case my focus of light should be in the middle of that open space, and the reflectors, four, five, or more in number, would find their place in each corner, or at such other position as would allow them to illuminate part of the streets leading thereinto.



The drawings, though primitive, explain themselves; in fact, whether it is with a street, a square, a circus, or a crescent, the plan can be carried out with advantage and economy.

Adapting this diffusing and reflecting system to the lighting of a railway station such as Charing-cross or Cannon-street, I should adopt a different form of lamp. My lamp in that case would be suspended to the roof, and would consist of two principal parts, viz., a screen underneath the focus just sufficiently large to prevent the naked rays from reaching the eyes of the spectator, and a reflecting diffuser over the focus having somewhat the form of a soup plate with a rounded bottom. The figure below showing a section has in A the focus of light, in B the screen, in C the reflecting diffuser, in D a covering of some sort when rain is to be feared, in E E a glass envelope, and in F the suspending hook.



From A the rays would strike at right angles on reflectors placed in different position against the walls of the station, and two lamps with source of light would amply be sufficient to illuminate the place without creating shadows. Such a form of lamp could be used in streets also, if suspended across them. Taking the place in front of the Mansion House, I should have such a lamp on a pillar in the middle and reflectors on the Mansion House, the Bank, the Royal Exchange, and, if necessary, at the corner of King William-street. I think I have said enough to show that by reflecting the light from one place to the other and diffusing it, many places could be lighted by electricity, which without would require too great expense to be attempted.

No doubt there may be some difficulties in the way, and the greatest is the form of the electric lamps now in use. The different parts they are composed of would prevent many from being used. I see, though, but little difficulties in carrying out my plan with the simple lamps of Jablochkoff, Rapieff, or Hendreich.

In conclusion, Sir, I have no doubt that many of the ideas I have hitherto given advocacy have also struck the able engineers who now direct the different systems of electric lighting, and that the only reason why they have not received more attention or application is probably due to representations made to them to the effect that if electric lighting cannot succeed unless it is made to follow the plans adopted for gas as nearly as possible, the sooner the agents who advise the inventors of electric lamps make contrary representations the sooner the public will enjoy the benefit of the light and the sooner it will be adopted in factories or in railway stations. A. VASSARD.

16, Annandale-road, East Greenwich, July 19.

POSTAL TELEGRAMS.

A deputation from the Council of the Society of Arts waited upon Mr. Fawcett, the Postmaster-General, at the General Post Office on Saturday, for the purpose of bringing before him the subject of the cost of inland telegrams, with a view to its reduction by the substitution of a minimum charge of sixpence for inland messages in place of the present charge of 1s. Amongst the gentlemen forming the deputation were Lord A. Churchill, Mr. Andrew Cassel, Mr. E. Chadwick, Mr. G. C. Barclay, Admiral Sir F. Nicholson-Banks, and Rear-Admiral Mayne, C.B.

Lord A. CHURCHILL and Mr. CHADWICK having urged that the hour had arrived when it was thought that a great advantage might be conferred upon the country by a reduction being made in the cost of telegrams, Mr. FAWCETT, in reply, said: No member of this deputation can recognise more fully or strongly than I do the great advantage which would be conferred upon the entire community by a reduction in the price of telegrams or by the adoption of any other means which would facilitate internal communication. Probably no service which can be rendered by a Government to a country is so great as that of facilitating the means of communication. In order that there may be no misunderstanding, I wish to state at the outset of my remarks with as much distinctness as possible that, so far as this department is concerned, there would be no objection to accept a reduction in the price of telegrams if the reduction could be justified. In saying this I think I am expressing the views of my colleagues and other officials of the department. In estimating what ought to be the price to be charged, I think we ought to keep steadily in view these two principles. If the price charged is not sufficient to make the telegraph service commercially remunerative the difference would have to be made up out of general taxation, and thus the general taxpayer would be fined in order to enable the senders of telegrams to send them at a lower rate than the market price. It seems to me that this would be just as indefensible as to impose a tax upon the community in order that a grant in aid of a certain class of wages might be given, or to give a bounty to some particular trade in order that the commodities of that trade might be sold below cost price. On the other hand, I wish with equal distinctness to state, that if a price is charged for a telegram more than sufficient to make the service remunerative, then the difference between the price which would make it remunerative and the price charged is really so much taxation imposed upon telegrams just in the same way as if the tax gatherer stood over the sender of the telegram and levied a tax at the moment telegram was sent. If it could be proved that eightpence would be a remunerative price, then if 1s. is charged 8d. is paid for the service rendered, and the other 4d. may be regarded as a tax imposed upon telegrams. It is obvious that it is not for this department, nor for me holding the office I hold, to express an opinion as to the way in which the taxation of the country should be raised, or whether it is advisable or not that the taxation of the country should be raised upon the means of internal communication. That is a question not for this department, but for the Chancellor of the Exchequer and the Government generally. The principles I have laid down at starting, I think it important to keep steadily in view, because it seems to me that upon them must chiefly be determined the price that ought to be charged for telegrams. Of course, every one would like to have the price of telegrams reduced, but the question must be determined by financial considerations, and those considerations I will endeavour to lay before you as distinctly as I can and with as much brevity as possible. The telegraph revenues show an improvement in the best sense of the word, because I find not only the gross receipts increasing, but the net receipts increasing in a more rapid ratio. I will give you the gross and net figures for the year 1876 and for the last financial year, which closed on the 31st March last, and you will see that they abundantly prove the satisfactory result I have mentioned. The gross receipts from the telegraphs in 1876 were £1,287,000, while the outlay for working expenses, renewals, &c., were £1,090,000, which shows a profit realised of £197,000. I refer to the year 1876, because it was the year in which a very important Select Committee of the House of Commons, presided over by Dr. Lyon Playfair, inquired into the telegraph system of the country. Passing on to the year which closed on the 31st March last, we find that the gross receipts have increased to no less a sum than £1,471,000, but that the working and other expenses have not increased in anything like the same ratio, owing to great economy being introduced into the service and in consequence of improvements in the means of telegraphing. This largely increased revenue was obtained at a comparatively slight addition of cost. I find that the working expenses only increased from £1,090,000 in 1876 to £1,117,000 last year, so that the profit for the last financial year was £354,000. The

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profit during the past four years has increased from £197,000 to £354,000. The result becomes the more satisfactory when we turn to the capital account. I find that this increase in profits of nearly £160,000 was obtained with a comparatively small addition to the capital account of about a million. During the present year the progress seems to be going on in an increasing ratio, for comparing the receipts from telegrams for the first three months of the present year with the corresponding three months of the previous year, I find an increase in receipts amounting to £80,000, and my friend Mr. Patey, the superintendent at the head of the department, considers, after making careful estimates, that the profit on telegraphs during the present year will amount to £450,000. Of course, a considerable portion of this increase is due to the extended work of the telegraphs and to the general advancement of the system throughout the country. But I am bound in candour to admit that no small part of this satisfactory result is due to the admirable manner in which the telegraph service has been managed by the permanent officials, and their readiness to adopt suggested economies and take advantage of scientific improvements. Having laid these financial results before you, I will proceed to consider what would be the best method of reducing the price of telegrams, and then I will lay before you what would be the probable result of the suggested reduction. Now, of all the many suggestions made for reducing the price there seems to be a particular one which has so many advantages over the others that I shall almost entirely confine my attention to it. As you are probably aware, all foreign telegrams are sent at what is known as the word rate. If, for instance, you send a telegram to France or Belgium the charge is at per word, and the result is that short telegrams can be sent to the Continent at less cost than those sent from one part of England to another. It seems to me that if any change be made in the present rate it should be in the direction which this country has so persistently pressed upon other countries. The plan suggested and which I would recommend is a modification of the word rate. I would propose, for instance, a halfpenny word rate, and that the minimum charge should be sixpence. Consequently a telegram of twelve words, including the address, could be sent for sixpence, and a halfpenny a word would be charged for every additional word. Now it seems that there are several advantages to be derived from the adoption of this particular method of charge. In the first place it would prevent the waste which prevails under the present system. It is notorious that in the great majority of telegrams sent a great many unnecessary words are used, and if the word rate were adopted this would not continue. Then another advantage would be that a person would be charged according to the amount of work which the State did for him. At present there is this anomaly—that a person may send a single word and a short address, and be charged as much as the person who sends 20 words and a long address. There has been a suggestion made, and I think it is well to refer to it, because I have often seen it discussed in the public prints—that you should have two rates of charges for telegrams—that you should have deferred telegrams, which should be charged at a cheaper rate. For instance, when you go to a telegraph office in the City those persons paying a shilling should have their telegrams sent at once, but those who paid sixpence should have theirs despatched after the shilling ones were all sent. I never would sanction such a scheme as that [hear, hear]. It seems to me to have attached to it the fatal blemish that it would always impress the public with unfairness, and every single person who did not get a telegram as soon as he expected would think the delay was owing to a preference shown to some favoured individual. It seems to me to be a principle of cardinal importance to maintain that there should be no distinction of persons—no distinction with regard to preference; but that the very first person who gets into the telegraph office should have his message sent first [hear, hear]. If any departure is made from this principle I am afraid that all confidence in the fairness of the telegraph service would be at once removed [hear, hear]. And now, having stated the arguments in favour of the particular method of the reduction of charge which I have suggested, I have next to direct your attention to the very important question as to what would be the financial effect—for this is really a financial question—of adopting what I will now briefly call a sixpenny telegram—understanding by that expression a sixpenny telegram with the modifications I have described. Soon after I was appointed to the office I now hold my attention was directed to the subject, and I asked Mr. Patey to prepare a careful estimate as to what would be the probable financial effect of reducing the telegrams to 6d. with a minimum of twelve words, and a halfpenny charge for each word beyond twelve. Mr. Patey devoted himself to the framing of this estimate with great assiduity. I have examined his estimates, and I am bound to say that they have been drawn up with great skill, and what is of equal importance, with great caution. I will give you briefly the result of Mr. Patey's calculations. He estimates that if the sixpenny rate had been adopted at the beginning of the present financial year increase in the business which it would have brought, and the increased staff which it would have necessitated, would have increased our working expenses by £50,000. He estimates that the loss of revenue on a total of £1,400,000 would have been £112,000; he estimates that during the present year an additional capital expenditure for new wires, and, in some cases, for new offices or for increased office accommodation, would have been required of £100,000. Treating this £100,000 as capital, and supposing we paid it off at a certain period by a sinking fund, I will consider that it represents an annual charge of £5,000. We, therefore, have this result—£50,000 for increased working expenses, £112,000 for loss of revenue, £5,000 as interest on extra capital, being a total of £167,000, which would represent the estimated cost of introducing a sixpenny telegram during the present financial year. Now, I think it is quite possible that some of you may be disappointed to hear that the introduction of a sixpenny telegram would lead to such an immediate loss of revenue as that which I have described. But it is important to bear in mind that I believe, with all the greatest improvements that have been introduced into the postal service of this country, they, almost without an exception, caused a loss of revenue in the first instance, whatever might be the larger result which followed afterwards. Thus, to take the greatest of all postal boons—I refer to the penny postage—it was at least 16 years, and some say it was 33 years, before the penny postage yielded as large a net revenue as that which was yielded by the more expensive postage before the penny postage was introduced. That being the case, we ought not to feel particularly disappointed that so great a reduction in the price of telegrams as that which I have suggested, whatever might be its ulterior financial consequences, would in its first year of introduction lead to the loss of £167,000. But it is, and may be again, said, "Well, if this loss is £167,000, why don't you introduce sixpenny telegrams on a limited scale? Why don't you confine their introduction to London and some large towns?" As a metropolitan member, you may suppose that I should not look unfavourably upon any proposal for giving a special accommodation to the metropolis. And it is said that London has special claims for a sixpenny telegram, because sixpenny telegrams existed in London before the telegraph companies were purchased by the State. Yes, sixpenny telegrams did exist for some time in London; but what was saved then with one hand was taken away by the other, because, although there were sixpenny telegrams in London, at that time so high a price was charged for porterage, that I believe it will be found that even with sixpenny telegrams, telegraphing was dearer in London then than now [hear]. Moreover, the facilities which have been afforded by the Government since they acquired the telegraph companies are rather remarkable. At the time of the purchase there were only 60 offices in London at which telegrams were received. At the present time the number of offices in London is more than 400, and the number is steadily increasing. So great an effect have these extended facilities had upon a large amount of telegraphic business that is done in London, that whereas at the time that the telegraphs were purchased by the State only 250,000 telegrams were received from one part of London to another in the year, now the number is no less than 1,500,000, which shows an increase of 600 per cent. But when we considered what would be the financial effect of confining the reduction in the price of telegrams to London and a few large towns, it was found that it would not to any very important extent diminish the loss to which I have referred. After a careful estimate I find that it only diminishes the loss of £167,000 by £50,000 or £60,000, and the loss would still be on the revenue of the year £120,000. When the confining of the cheap telegrams to London or to London and a few large towns, instead of extending them over the entire country, would only make a difference of some £50,000 or £60,000 a year, it seems to me that for this small amount it would be extremely unfortunate to depart from the most important principle of uniformity, and for the sake of £60,000 to deprive the entire country of the boon of having a cheap and uniform system of telegrams [hear, hear]. Therefore, so far as I am at prevent advised, I would rather wait a little longer—a year or two—and have the thing completely done than have it done, as it were, in this partial and spasmodic manner [hear, hear]. You will remember that I said that the estimated profit on the telegraphic service of the present year is £450,000. It is estimated that if a sixpenny rate were introduced the diminution of revenue would be £167,000, that taken from £450,000 leaves £283,000, and this is the estimated profit on the present year if a sixpenny rate had been introduced. Let us now consider whether such a profit as this would or would not be a sufficient return for the capital which had been expended. In considering the capital of the telegraph service I come to by far the most perplexing part

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of the problem. Ought we, in estimating the capital of the telegraphs, to include all the money that was wasted in a careless purchase, or ought we simply to consider as the true capital of the telegraph service what would have been the capital sufficient to acquire the telegraphs if the bargain had been more judiciously carried out, or if the State had constructed the telegraph service for itself? Starting with the first proposition, and including as capital all the money wasted in the careless bargain, I find the capital of the telegraph service at the present time is £10,500,000, and consequently the profit of £283,000 would return on this capital a rate of interest of about 2½ per cent., which would be somewhat below the current rate. If, however, you take a careful estimate of what was the amount wasted owing to the carelessness with which the telegraphs were purchased, and if you take this amount of waste at £3,000,000 or £3,500,000—and I am afraid that is an extremely low estimate [hear, hear]—and write it off as a bad debt (and that is what perhaps might be done), you would then reduce the true capital of the telegraph service to some £7,000,000, and a profit of £283,000 upon a capital of £7,000,000 would represent a return of 3½ per cent.; and this would show that even with a sixpenny rate the telegrams would more than pay all their expenses, and more than pay the current rate of interest on the capital expended [hear, hear]. I think I have said enough to show you that the question of the reduction of the price of telegrams is, after all, a financial one, which cannot be determined by me or by this department, but is one which must be determined by the Chancellor of the Exchequer and the Government generally. I have done no more than to lay the elements of the problem before you, and I hope that they may perhaps contribute to the solution of the problem. In conclusion I will only make this one remark, and it seems to me important to bear it in mind, that I cannot help thinking that the true position of the Post Office in this country is sometimes not kept sufficiently distinctly in view. It seems to me to be too often forgotten that this office has two distinct functions to discharge. We have in the first place to supply a revenue to the Chancellor of the Exchequer, and in the second place we have to supply certain services for the country. The amount of the revenue which we have to raise for the Chancellor of the Exchequer is not for us to determine—that is a part of the general policy of the Government; but what we have to do is to obtain that revenue with the least inconvenience—or, perhaps, I should rather say with the conferring of the maximum amount of advantage upon the entire community [hear, hear]. If it should be decided that the country is in a position to afford this sacrifice of revenue of £167,000—which is the sacrifice we estimate would be involved in the reduction to a sixpenny rate—then I should say, if it should be decided that the country could bear this sacrifice of revenue, that not a word of opposition would be offered from this department [hear, hear]. We should accept the decision, and we should endeavour, as far as possible, to make a sixpenny telegram work as efficiently as the shilling telegrams have done up to the present time.

The deputation, having thanked Mr. Fawcett for his courtesy, then retired.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.

The half-yearly general meeting of this Company was held on the 20th inst. at the company's offices, 38, Old Broad-street; Sir Daniel Gooch, Bart., in the chair.

Mr. W. Shuter (the Secretary) read the notice calling the meeting.

The Chairman said: Gentlemen, as the object of this meeting is more to give you a short account of the work which is in hand than for anything else, I will state shortly to you what we have done during the last half year. We have laid 120 miles of cable in New Zealand. We have laid 550 miles of the Hong Kong and Manila line; we have made a contract with the Anglo-American Company, just about the time of our last meeting, for laying 1,500 miles of cable, with the view of repairing the 1866 cable of their system, and also to lay a new cable between Newfoundland and Nova Scotia, about 290 miles long. The ship with the latter portion left on the 11th inst., and I hope she is on the ground now. The "Scotia" will leave before the end of the month, and the "Kangaroo" with the remaining portion of the Atlannic cable, and we hope in a very short time these services will be successfully completed. I may state that Captain Slocomb is in charge of the expedition, and his experience and care in these matters give us great confidence that everything will go well. Then we have sent a ship, just started, a ship with a small house and land lines that we had to complete the Cape cables, and when those are finished that is the last work at the Cape we have got to do. That is all I have to say with regard to the work done during the half year. The work that we have got in future we do not know much about. We are negotiating now for some cable, but it is as yet indefinite, and in future we are dependent a little on what orders may come in. I shall be very glad to answer any questions, but I do not know that I can answer any questions.

Mr. William Abbott: You always look at me at these half-yearly meetings as much as to say, "Well, Mr. Abbott, you have had your half-yearly meeting and I am here to answer any questions should you like to draw any information from me," but I do not think it at all necessary upon this occasion to add any further remarks to the statement you have just made. It shows that not only have we a contract for a new Atlantic cable, but also you have other works in connection with the Anglo-American. You have completed works in connection with the Manila Telegraph Company, and, although you never do see any particular prospect of work before you, at the same time I have not the slightest doubt these negotiations which are now pending, and on which it would not be advisable for you to say much, will bring results equally satisfactory to those you have just now dilated upon. I must say, Sir, as a shareholder of the Telegraph Construction Company, I had considerable pride in looking at those two splendid vessels in the Thames a short time ago. There is one point you have not touched upon, and that is the financial operation you have carried to a successful completion in connection with the Eastern Telegraph Company. At the meeting of the Eastern Telegraph Company it was publicly announced—and therefore there is no secret, and so there is no necessity to have any reservation about it, though you like to keep these things rather dark—that you sold a very large number of shares in the Cape of Good Hope Telegraph Company which you took in payment for your work. Well, Sir, it may be as satisfactory to you as it is also satisfactory to the Eastern Telegraph Company to know that your enterprise there has been amply rewarded, and that the estimate you formed of the traffic to go through that Cape cable has been considerably exceeded.

The Chairman: I did not mention anything in regard to the Cape cable because I thought the shareholders were perfectly aware we did take, and had to take to carry the work through, a very large amount of stock to secure its completion, and I am glad to say, as Mr. Abbott puts it, we have disposed of that stock, and it is satisfactory to us that we have done so, and it will be beneficial to the shareholders [cheers].

Mr. William Abbott: That being the end of the meeting, I have much pleasure in proposing a hearty vote of thanks to the directors for meeting us to-day. I do not think the resolution of the general meeting of Feb. 28, 1871, that half-yearly meetings of this company should be held, that the wisdom of the resolution has ever been made more manifest than to-day.

Mr. Spencer: I beg to second the resolution.

The resolution was put and carried unanimously.

The Chairman: It is always a pleasure to us to meet you if you think it worth your while to meet us for so little. It is no inconvenience to us, it is only an inconvenience to you.

The proceedings then terminated.

CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

The eighteenth ordinary general meeting of this Company was held on the 21st instant, at the offices, Old Broad-street; Mr. Thomas Hughes, Q.C., presiding.

The Secretary (Mr. James Scott) read the notice convening the meeting, and the report—which appeared in our last issue—was taken as read.

The Chairman, in moving the adoption of the report and accounts, said he had very little to state beyond what was contained in them. The Company had been, as they saw, fairly prosperous. The traffic receipts were £1,000 in excess of those of the corresponding period of last year, which was an increase of 6½ per cent. Of course, it had been stated that the increase ought to be 10 per cent.; but he did not think that that had been the experience of many companies of late years. At any rate, he thought they would agree that an increase of 6½ per cent. was satisfactory in these times, and as much as they had any right to expect. With regard to the disposal of the large amount earned, they would see that the directors, in consequence of what had fallen from shareholders at other meetings, had recommended an increased dividend at the rate of 7 per cent., after carrying to the reserve fund the sum of £4,200, which was slightly in advance of the sum carried to the reserve at the corresponding meeting last year. Of course they would see why it was necessary. After the carrying over of the amount to the reserve there still remained nearly £4,000 more, which, of course, was applicable to the payment of dividend, but he need not tell them, as they could all see, the reasons why they proposed to carry that sum forward instead of dividing it. A fault had again occurred in the old cable, and at the present time their manager, Mr. Keith, was engaged upon repairing it. Therefore, he thought that the shareholders would agree that it was necessary to provide for the repairs of that fault. He knew of nothing else that he need call attention to. Practically things remained just as they did when they last met, and nothing of interest had occurred to which he need specially refer.

Mr. A. F. Low having seconded the motion,

Mr. John Newton asked whether the break had occurred in the same part as before.

The Chairman, in reply, said they at first thought that it was in the same place, but from what they had now learned it seemed to be further out. At first they thought it was almost the same place, and that there must be some sharp point upon which the cable rubbed, and that by taking the new cable out for a few miles they might round that point.

A Shareholder asked what the expense would be.

The Chairman said it depended upon how many days were taken to repair the fault. The manager was out there, and he was a skilled cable man. He had hired a vessel on the spot, and had sent it out, so much a day was paid for it, and the expenses would depend on the number of days the vessel was out.

Mr. Newton observed that as there was a sum of £677 interest to date on the reserve fund, that should be considered as revenue, and credit should be taken for it.

The Chairman put the resolution, and it was carried unanimously. He then proposed a dividend for the half-year at the rate of 7 per cent. on the ordinary shares, and 10 per cent. on the preference, payable on the 22nd instant.

Mr. Low seconded the motion, which was carried unanimously.

Mr. Neil Bannatyne, in proposing the re-election of Mr. Hughes as a director, observed that the services rendered by that gentleman had extended over a long period, and he was so well known to every one con-

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nected with the Company that he need say nothing further to recommend the resolution for his re-election to their approval.

Mr. Low seconded the motion, which was carried unanimously.

The Chairman in acknowledging his re-election, stated that the duties of his post, whatever they might be in future, were not at present very onerous. He then moved the re-appointment of Mr. Cowan as auditor at a salary of 20 guineas.

Mr. Cochran seconded the motion, and it was carried unanimously.

Mr. Cowan, in returning thanks, testified to the efficient manner in which the books were kept by the officers of the company.

A vote of thanks was then passed to the chairman and directors.

The Chairman, in reply, expressed his obligations for the manner in which the vote had been proposed and carried by the meeting. The directors had done their best for the Company, and he believed that if the business were properly conducted, and the times were favourable, there was a good future before the Company.

The proceedings then terminated.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).

Report of the directors for the six months ending June 30th, 1880, to be presented at the sixth ordinary general meeting of the Company, to be held at the City Terminus Hotel, Cannon-street, in the City of London, on Thurspay, the 29th day of July, 1880, at 12 o'clock noon:—With this report the directors submit the usual statements of account for the half-year ending 30th June, 1880, which, with the half-year's accounts to the 31st December last, presented at the ordinary general meeting on the 27th February last, show the financial result of the third year's working of the company. The revenue for the half-year, after deducting out-payments, amounted to £82,149 0s. 3d. The working and other expenses for the same period, including interest on debentures, and income tax, &c., amounted to £22,863 13s. 9d., leaving a balance of £59,285 6s. 6d. as the net profit for the half-year; making, with £15,677 16s. 7d. brought forward ward from the previous half year, a total of £74,963 3s. 1d. Three quarterly interim dividends of 1¼ per cent. each, amounting to £45,532 10s., have been declared and paid at the usual times during the financial year, and a final dividend of 5s. per share is now proposed, making, with the three interim dividends, 5 per cent. for the year, being a total distribution of £60,710. The appropriation of the above balance of £74,963 3s. 1d. on the revenue aczount is thus shown:—Interim dividend for quarter ending 31st March last, £15,177 10s.; final dividend now proposed, £15,177 10s.; carried to reserve fund, thereby increasing it to £175,000, £22,847 14s. 3d.; carried forward to next account, £21,760 8s. 10d.—total £74,963 3s. 1d. The cables are now, and have been during the past year, in good working order. The cable of the Compagnie Francaise du Telegraphe de Paris à New York having opened for traffic, the English companies have met the competition thus forced upon them, by the reduction of rates. The application of the duplex system has largely increased the carrying power of the Company's cable. The directors have had under consideration the question of establishing an assurance fund for the Company's staff on the same principle as that recently sanctioned by the shareholders of the Anglo-American and Eastern Telegraph Companies, viz., to enable the staff to secure the payment to themselves of a limited sum at a given age, or to their families in case of death, the Company paying one half the requisite premiums. The total cost to this Company would not exceed £1,000 per annum. The directors recommend this measure to the shareholders as being one calculated to promote the efficiency of the service by encouraging the staff to remain permanently attached to the Company. A resolution empowering the directors to carry out the above arrangement will be submitted to the meeting. Pursuant to the provisions of the articles of association two of the directors, viz:—William Ford, Esq., and C. J. Gunther, Esq., retire by rotation, and being eligible offer themselves for re-election. Mr. J. G. Griffiths and Mr. Joseph Sawyer, the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

THE GLOBE TELEGRAPH AND TRUST COMPANY (LIMITED).

Report of the dieectors to be presented to the seventh ordinary general meeting, 30th July, 1880:—The balance sheet and accounts for the year ending 18th July, 1880, with statement of the stocks and shares held by the Company at that date, are herewith submitted. The net revenue of the Company for the year, after deduction of expenses, amounts to £169,587 13s. 7d. which, with the balance of £973 14s. 1d. brought forward, makes a total of £160,561 7s. 8d. From this amount there has been distributed in interim dividends the sum of £119,887 14s., and the directors have written a further sum of £1,000 off the preliminary expenses account, leaving an available balance of £49,673 13s. 8d. The directors now recommend payment of a final dividend for the year of 3s. per share on the preference shares, and of 3s. per share on the ordinary shares (making, with the former distributions, a total dividend for the year of 6 per cent. upon the preference and 4½ per cent. upon the ordinary shares), carrying forward a balance of £841 12s. 8d. The directors have issued 4,000 preference and 4,000 ordinary shares of £10 each in exchange for 4,000 £20 shares of the German Norwegian Submarine Cable Company. This company was formed in Berlin in 1879, with a capital of £87,500, for laying a cable between Germany and Norway, upon the basis of a subvention of £7,000 per annum from the German Government, with a share in the tariff receipts. The capital is to be redeemed by an amortisation fund and yearly drawings. The dividend runs from the 1st January last, and is estimated to be not less than 6 per cent. per annum, although no payment will be received in time to appear in this year's accounts. Twelve shares have since been drawn and paid off at par in accordance with the statutes. Exchanges have also been made for the following, viz.:—115 Submarine Trust £100 Certificates, 1,600 Eastern Extension £10 Shares, 100 Eastern Telegraph £10 Shares, and 374 Indo-European £25 Shares. The thirty-nine Five per Cent. Debentures of the Western and Brazilian Company of £10 each, issued at £8, have been paid off at par. In conformity with the articles of association, Mr. John Pender, M.P., and Sir James Anderson, two of the directors retire, but being eligible they offer themselves for re-election. The auditors, William Newmarch, Esq., and John George Griffiths, Esq., also retire at the meeting, and offer themselves for re-election.

SUBMARINE CABLES TRUST.

Report of the trustees to the ninth ordinary annual meeting of the certificate holders, to be held at the offices of the Trust, No. 66, Old Broad-London, on the 30th of July:—The accounts for the financial year, which ended on the 15th April, are submitted herewith. These accounts were prepared and audited to show the actual receipts and disbursements during the twelve months. As the dividend which had accrued on the shares of the Eastern Extension Telegraph Company to 31st December, 1879, amounting to £1,696 was not paid until April 21st, it is not included in the revenue account now submitted, but will be brought to the credit of the current financial year. The revenue for the twelve months to 15th April, including a balance of £11,913 15s. 4d. brought from last year's accounts, amounted to £35,046 6s. 6d. The expenses of the trust absorbed £1,420 14s. 11d., leaving an available balance of £33,625 11s. 7d. From this sum three coupons have been met amounting to £31,086, carrying forward a balance of £2,539 11s. 7d. The certificate holders will remember that in April last year an injunction was granted by the Master of the Rolls, restraining the trustees from dealing with the funds of the trust except under the direction of the court. In January last a decree was made ordering the trust to be wound up. Against this action the trustees appealed, and a decision has just been given by the Lords Justices reversing the decree of the Master of the Rolls. The securities held by the trustees are precisely the same as on the date of the last report. The meeting will have to elect auditors for the current year. Mr. William Newmarch, F.R.S., and Mr. J. G. Griffiths (Messrs. Deloitte, Dever, Griffiths and Co.) retire, and, being eligible, offer themselves for re-election.

ABSTRACT OF PATENTS.

4589. Generating Electric Currents, &c., *C. F. Heinrichs.—Dated 11th November*, 1879. 2*s*.

This relates partly to means for generating electric currents to be used for the production of electric light, &c., and consists in an improvement on the Paccinotti rotating ring, armature, or induction coil.

4590. Electric Lighting, *G. P. Harding.—Dated 11th November*, 1879 6*d*.

This relates to the position and feed of the carbons or electrodes and to the relighting of the electrodes when extinguished.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices July 21.		Business Done Week Ending July 21. Highest.		Lowest.	
Anglo-American Ordinary	62¾,	63¼	..... 63¼	.....	62¼	
Do. "B"	92¼,	93	 93	.....	92¼	
Do. "A"	35½,	36	 36	.....	35½	
Brazilian	8⅜,	⅞	..... 8⅞	.....	8 11-16	
Cuba	10,	10½	..... 10½	.....	10⅜	
Do. Ten per Cent. Pref:	16½,	17⅓	..... —	.....	—	
Direct Spanish	1¾,	2¼	..... —	.....	—	
Do. Ten per Cent. Preference	11½,	¾	..... —	.....	—	
Direct United States	11⅝,	12⅜	..... 12⅛	.....	11¾	
Eastern	9 7-16, 9-16		..... 9⅝	.....	9⅜	
Do. Six per Cent. Debenture	103,	106	..... —	.....	—	
Do. Five per Cent. do. 1899...	105,	108	 107	.....	107	
Do. Six p Ct. Preference	12¼,	½	..... 12½	.....	11⅞	
Eastern Extension	9 7-16, 9-16		..... 9½	.....	9 7-16	
Do. Six per Cent. Deb.	108,	111	..... —	.....	—	
German Union	9,	½	..... 9½	.....	9	
Globe Telegraph & Trust	6 9-16, 11-16		..... 6⅝	.....	6 5-16	
Do. Six p Ct. Preference	12¼,	⅜	..... 12⅜	.....	12¼	
Great Northern	9⅜,	⅝	..... 9⅝	.....	9⅜	
Indo-European	23½,	24½	..... 24½	.....	24	
Mediterranean Extension	3,	3½	..... —	.....	—	
Do. Eight per Cent. Preference.....	10¾,	11	..... —	.....	—	
Reuter's	9½,	10⅓	..... —	.....	—	
Submarine	247,	253	 250	.....	250	
West India and Panama	1 9-16, 11-16		..... 1⅝	.....	1 1-16	
Do. Six per Cent. 1st Preference...	7¼,	½	..... 7⅜	.....	6⅞	
Western and Brazilian	6½,	¾	 7	.....	6⅝	
West. Union 7 p. Ct. 1st Mt.	120,	125	 121	.....	121	
Do. Six per Ct. Sterg.	104,	107	..... —	.....	—	

TRAFFIC RECEIPTS FOR JUNE, 1880.

Companies.	June, 1880.	June, 1879.	Increse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,700 estd.	2,425	275	—
Direct Spanish Telegraph Company	1,277 estd.	1,025	252	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	—	—	—	—
Eastern Extension Telegraph Company	29,100	26,485	2,615	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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SLIP

APPOINTMENT.—Mr. B. Ffinch, deputy director of telegraphs, Persian Gulf, is appointed Justice of Peace for the Mekran coast.

THE NEW ATLANTIC CABLE.—The section of the Anglo-American Company's cable between Placentia and St. Pierre has been successfully laid.

"THE UNIVERSAL ENGINEER."—The issue of this paper for July 16 contains a portrait and a sketch of the life of C. William Siemens, D.C.L., LL.D., F.R.S.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—The extra charge of 1s. 3d. per word for telegrams to and from the West Coast of South America has been discontinued.

SCIENCE.—We have received from New York the first two numbers of a new paper, entitled *Science*. The paper is intended to chronicle progress in all branches of Science.

CHRONOGRAPH.—Professor Pritchard, at a late meeting of the Astronomical Society, described a modification of the Morse telegraph instrument, whereby he obtained a reliable chronograph.

ELECTRICITY AND RAILWAYS.—At East Oakland, California, the train is caused to run over an insulated rail, and thereby automatically display a red signal at the end of the trestlework viaduct.

THE TELEPHONE EXCHANGE.—The fusion of the late Bell and Edison companies is complete, and henceforth the Metropolitan Exchange stations will be open from nine a.m. to seven p.m., except Saturdays, when the hours will be from nine to five.

ELECTRICITY AT THE THE THEATRE.—On page 109, in our last issue, we erroneously attributed to another paper an interesting article which appeared in *La Lumière Electrique* on various forms of electrical apparatus employed for the production of striking scenic effects.

THE SYDNEY EXHIBITION.—Messrs. Felten and Guilleaume, of Mülheim-on-the-Rhine, near Cologne, have been awarded a first class medal at the Sydney Exhibition for excellence of manufacture in telegraph and fencing wire, &c. Mr. W. F. Dennis, of 101, Leadenhall-street, London, E.C., is their agent for this country.

TELEGRAPHY IN ENGLAND.—This is the title of a note given by our contemporary, the *Universal Engineer*, in which the ignorance of the extractor or abstractor is again conspicuous. This paper seems to have a fatal facility for mistakes. The information given is not from a report, but from a paper read to the Society of Telegraph Engineers.

"ANNALEN DER PHYSIK UND CHEMIE."—The current number of this periodical contains, among other papers: Electric Deposition, by G. Quincke; Thermal and Optical Phenomena of Gases under the Influence of the Electric Current, by G. E. Wiedermann; The Polarisation of Light due to Electro-Magnetism, by A. Kundt and W. C. Kötgen.

TELEGRAPHIC NEWS IN THE HOUSE.—On Monday, in reply to Mr. M. Guest, Mr. Adam said the question of having telegraphic instruments placed in the library, cloak-room, smoking-room, or any other part of the House for the convenience of hon. members involved consultation with the Speaker, the Postmaster-General, and the Treasury. He could not promise more at present than that the subject should be fully considered.

PROGRESS OF THE ELECTRIC LIGHT.—A correspondent informs us that the Municipality of Havre have just entered into a contract with the Société Générale d'Electricité (Jablochkoff's patent) for lighting up by electricity the harbour and docks of Havre. This contract follows that between the Chemin de fer de l'Etat Belge, also with the Société Générale d'Electricité for lighting the Antwerp basins. In both cases the contract is for ten years.

AUSTRALIAN TLEGRAPHY.—The Postmaster-General of South Australia has received a letter from the Deputy Post-Master of Victoria, acknowledging the receipt of a letter, notifying the approaching completion of the proposed new telegraph line between Adelaide and Melbourne, and stating in reply to Mr. Todd's inquiry respecting the progress made in Victoria with the line to connect therewith, that directions have been given for a survey of a line from Dimboola to be proceeded with immediately, with a view to establish the necessary connection at as early a date as practicable.

THE TELEPHONE AND FIREDAMP.—It is well known that if a long dry tube, open at both ends, be held over a jet of burning hydrogen a musical sound is produced the pitch and quality of which vary with the length, thickness, and diameter of the tube. It has been proposed to adapt such a tube to the safety lamp underground, and to place it near a telephone in communication with another telephone in the manager's office on the surface. The alteration of the sound, due to a greater or less admixture of gas with the air of the mine, would warn the manager of the state of the atmosphere in the workings.

SWANSEA.—During the Sunday School Centenary service the strains of the chorus in the music hall were distinctly heard at the end of a telephonic circuit of nearly a mile in length. The apparatus was fixed by Mr. J. Legg, who is about to connect the Velindre Waterworks with the Town Hall, a line nine miles in length. We hear that the same gentleman has just received an order from Madame Adelina Patti to put up a line between her castle (Craig-y-nos) and Penwyllt Railway Station, so that orders for carriages to meet guests may be given. The telephone used is the Gower Bell, which gives great satisfaction.

THE UNDERGROUND TELEGRAPH IN VIENNA.—The cable, made by Messrs. Rattier and Co. of Paris, consists of a strand of seven copper wires 0·6 mm. in diameter, surrounded by a gutta percha covering 5 mm. external diameter, with a coating of tarred cotton-wool yarn. Seven of these cores form one cable, and protected with—1st, a tarred woollen ribbon; 2nd, a tarred hemp covering, dipped previously in a solution of sulphate of copper; 3rd, a second tarred woollen ribbon. Each core has a conductivity from 91 to 98 per cent. of that of pure copper, an insulation from 1,100 to 3,000 megohms per kilometre at 20° C., and a capacity 0·21 to 0·25 microfarads per kilometre. The weight of each core is, according to the contract, within 5 per cent. of 390 kilometres per kilometre. The tar was quite free from acid, but the hemp covering was slightly acid from being dipped in the copper sulphate solution. The cable was made in lengths of 500 metres, and laid at a depth of 1·3 metres in a box of red larch-wood, several such cables being stretched in the box, and separated from one another by a mixture of one part of Beocsimer cement and two parts of sand. Where the cable crossed the Franzensketten bridge, the wires, to avoid damage from the vibration, were not stretched tight, but laid simply in a layer of sifted coal ashes placed in the box. A channel 0·8 m. wide and about 1·4 m. deep was dug for the wires to lie in, and the bottom made quite smooth; the depth, 1·4 m., being always followed except when gas

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pipes, &c., had to be avoided. The boxes in which the wires were laid were from 3 to 5 m. long. The cable, containing seven distinct conductors, cost about £112 per kilometre, and the complete cost of making and laying £4,202 kilometres of subterranean line containing 33,431 kilometres of cable was about £5,500.—Abstract of a paper by M. Zelli, in *Electrotechnische Zeitschrift*, in *Jnl. Soc. Tel. Eng.*

The English "Direct" Cable.—There is no doubt, says a correspondent to the *Paris Bourse*, that the French Cable Company would like the public to ignore the existence of the English cable companies, and we have been tempted to make some inquiries as to the working of these companies, especially with regard to the "Direct" Cable Company, and we find that beyond all doubt the word "direct" applied to their cable is no misnomer, as it in reality is the most independent connection that has yet been established with the United States. It is the only company working through to New York itself, and there are two transmissions less by it than by any other route. The tariff of the company is 1s. 6d. per word, and by this means they have afforded to the public a special and speedy service for Atlantic telegrams, and we are assured that the public have largely availed themselves of the facilities thus afforded by the English companies, and that the Direct Company has a high reputation for the speed and accuracy with which they deal with their business, and that there is absolutely no foundation for the statement that there has been any delay over its systems. We may here mention that the announcement of the result of the "Derby" race this year was transmitted from London to New York by direct cable in 25 seconds. Last year it occupied 42 seconds, the reason of its being quicker this year being due to the number of transmissions being less than they were last year. The news respecting the recent American Rifle Shooting Match in Dublin—an event watched with great interest by the New York public—was also forwarded by the Direct Cable Company much quicker than by the the French cable. We have drawn attention to this subject to show that the English companies are alive to what is required of them, and that, while by the Anglo Company the public are afforded the cheaper tariff, the cable of the Direct Company is reserved as a special route for more important and urgent telegrams. It is also noteworthy that the tariff is cheaper than by the French cable.

The Temperature of the Sun.—In our issue of July 3, we gave a communication on this question of Mr. Sawyer to the *Scientific American*. Since then the following have appeared in that paper. Mr. O. E. Town says:—"On page 405 of your issue of June 26, 1880, in the article entitled, 'What is the Temperature of the Sun?' I discover a singular error. Mr. Sawyer estimates the diameter of the earth's orbit to be 190,000,000 miles, and the diameter of the sun at 800,000 miles, the diameter of the orbit being 237·5 times the sun's diameter. He thereupon computes the surface of the imaginary hollow sphere of 190,000,000 of miles diameter at 237·5 times that of the sun, instead of using the *cube* of 237·5 as the multiplier. Correcting this error, Mr. Sawyer's figures would make the temperature of the sun 1,339,648,437°, which will hardly corroborate his first estimate, in which all the sums on which he bases his calculations are assumed." Mr. T. Robinson says:—"In your paper of June 26, 1880, there is an attempt to answer this question. By a comparison with that of the voltaic arc, W. E. Sawyer finds the temperature of the sun to be 'not less than 12,000°, nor more than 50,000° Fah.' and then in 'another way,' evidently peculiar to himself, he obtains a similar result. The *other way*, Mr. Editor, is unique! Look at it a little. Assuming the mean distance of the sun to b 95,000,000 miles, Mr. Sawyer proceeds to obtain the diameter of the earth's orbit by doubling its mean radius and adding 800,000. Why add the diameter of the sun? He evidently is not aware that the linear distances of heavenly bodies are calculated from centre to centre. Again, imagining the diameter of the earth's orbit to be that of a hollow sphere concentric with the sun, he states that the surface of that sphere would be '237·5 times the surface of the sun,' because, forsooth, 'the diameter of the sun is contained in the diameter of the earth's orbit 237·5 times.' Mathematics teach that *similar surfaces vary as the squares of their homologous lines;* that is, the surface of the hollow sphere will be to that of the sun as the square of 237·5 is to the square of 1, as 56,406·25 : 1. Now the heat from 1 square foot of the sun's surface will be spread over 56,406·25 square feet of our assumed sphere, and its intensity on 1 square foot must be less than 1-56406 of what it is at the sun. If, then, we take the assumed mean of 100° at the earth, the temperature of the sun must be 5,640,625°, which corresponds more with the figures of 'those who have estimated into the millions' than with what W. E. Sawyer has observed in electric temperatures."

Electricity v. Colliery Explosions.—Mr. S. Walker thus writes on this subject to the *Colliery Guardian*:—"Sir: The occurrence of another fatal colliery explosion causes one to consider, cannot something be done, by means of electricity, to prevent them? I think something may be done I think with the assistance of colliery managers and mining engineers to guide us in our labours, we may be able to arrange an electrical apparatus that will give sufficient warning to enable such precautions to be taken as will avoid an explosion. In the first place I would ask mining engineers and colliery managers—1. With how much warning can you prevent an explosion? 2. Is there any force present in colliery explosions, such as an increase or decrease of pressure on the barometric column, or an increase or decrease of temperature? If either of these forces or anything analogous be at work, and by its means we can ensure a column of mercury or a steel spring being forced through a very small fraction of an inch, the following plan may be carried out. The length of time warning that the apparatus will give must necessarily depend upon the amount of information we can obtain as to the phenomena immediately preceding an explosion. My plan is as follows:—Let a good loud alarm bell (electric trembling bell) be fixed at each point to which it is desirable that an alarm should be given—say in the fan, winding and engine houses at the pit bank, at the pit bottom, at the entrance to each road and to each heading; and let the bells be connected with a battery or dynamo-electric machine on the bank, and with an apparatus consisting either of a column of mercury or other suitable arrangement to make or break the electric circuit when either the pressure reached a certain fixed limit or the temperature rose above a certain degree, or any other force that may be discovered to have passed its limit of safety, and with wires in such a manner that immediately on the limit above referred to being reached the whole of the bells would ring simultaneously, and would go on ringing either till stopped by hand or till the conditions of safety had been restored. I am aware that two principal objections will be raised:—1. Expense. On this head I submit that the cost of erection and maintenance for ten years would not exceed 1-1000th part of the cost of an explosion. 2. The difficulty of maintenance and of ensuring that the

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apparatus was always in proper working order. This difficulty would disappear as soon as it was fairly met. We should arrange the apparatus so that a glance at a dial in the engine house, fan engine, or any other desirable place would show as certainly if the apparatus was in order as do the movements of the hands that a clock is going. Further, it would be in the power of each deputy and underviewer to test each and every part of the apparatus at any time, and this should be done as regularly as the examination of the rope. Also, any breakage of the wires in any place would cause the alarm to commence ringing, and should any accident happen to any particular bell, that bell would commence ringing by itself. A dial as above described might be placed in the manager's office, and if required, also in his house. There would be no difficulty about the wires. They should be stout copper wires, thickly covered with gutta percha. They should be fixed well out of the way and protected with wood boarding. Any exposed places should be examined periodically, and in case of alterations fresh wires should be fixed temporarily in another position while the alterations were being made. The battery, if one was used, would be of a very simple construction, and it would literally call out when it required attention. If a dynamo-electric machine was used, the same would suffice to work all the electric signals in and about the colliery."

HEAT THEORY OF THE GALVANIC CURRENT.—Clausius points out that Helmholtz's contact theory is inadequate, and he chose to elaborate the theory of the Dutch physicist, Buys-Ballot—that at the contact of two metals, the movement of heat itself causes potential differences. Thomson has given a theory of thermo-electric currents, which is complete, if we assume that the Peltier effect will show itself in one and the same metal at different temperatures. Tait has proved the well-known formula of Avenarius, and Edlund has proved the formula of Thomson—that the electromotive force of a thermo-element at the same difference of temperature is proportional to the absolute temperature. In the rational explanation of thermo-electric phenomena there are inconsistencies :—(1) Thomson's careful experiments still leave it doubtful whether we really find Peltier's effects showing itself in one metal; (2) bismuth is positive to antimony, and yet the current flows in the heated junction from bismuth to antimony; (3) Peclet has proved that with increased temperature the contact difference of zinc and gold is unchanged. (1). The author describes how, using weak currents, he gets the result which Thomson obtained using strong currents. (2). The author gives lists of metals placed according to experiments such as those of Volta and according to thermo-electric experiments. He finds by his own experiments the following contact differences with brass, given in percentages of a Daniell;—zinc 80, bismuth 16, antimony 12·5, silver 4, platinum I. 2·0, copper 1, platinum II. 4·0 gold 8. Platinum I. was chemically pure; platinum II. was the metal of commerce. This list, deduced from the author's careful experiments, he says, proves that the results of Volta, Seebeck and others are correct, in spite of the obvious carelessness of their methods. He goes on to show that, for instance, in a bismuth-copper junction, the electromotive force produced in the bismuth itself tending to give a strong current from cold to hot parts of the metal, is actually greater than the contact electromotive force of the two metals; and hence, since there is only a small effect of this kind produced in copper, these metals ought to be differently placed in a contact list and in a thermo-electric list. This is also the reason why we find the neutral points in thermo-electricity. The author gives an experiment bearing out the above explanation. (3) He repeats Peclet's experiment, and gets a result which is in accordance with theory. He, therefore, concludes that potential differences shown on heating are only modifications of those discovered by Volta; and as thermo-electric phenomena are explainable by the laws of thermo-dynamics he uses to explain Volta's contact differences, heat effects at the junctions. He deduces from this that not merely chains of metals, but chains of metals and liquids should owe their electric currents to heat effects at the junctions; so that we must not explain them by changes in chemical effects. He discusses the case of zinc in sulphate of zinc, where there is an electromotive force of contact, and yet in which there is no chemical action. He describes an experiment showing that the positive electrode in a decomposition cell becomes warmer than the negative. The author describes arrangements by means of which zinc plates were maintained at different temperatures in sulphate of zinc, and copper plates in sulphate of copper, and he finds that the ratio of the electromotive forces of these cells is 1·26. He also finds that the thermal currents between metals and fluids depend, as regard their direction, only on the fluids, and not on the nature of the metals. The author, after declaring that the question—Is the electromotive force of Daniell equal to the sum of—

$$Zn \mid Cu,\ Zn \mid Zn\ So_4,\ Cu \mid Cu\ So_4$$

has not hitherto been taken up, proceeds to describe his experiments proving that this is true. He finds—

$Zn \mid Zn\ So_4$, = 48 per cent. of a Daniell,
$Cu \mid Cu\ So_4$ = 27·4 ,, ,,

He then proceeds to consider the well-known statement that the direction of the current in a cell depends on the nature of the chemical effects producible at the junctions, and he shows by the example of a single cell formed of lead and copper in water that the statement is not always true. Thus, according to Favre—

$Pb\ O - H_2\ O = 27{,}675 - 34{,}462 = -6{,}787$ heat units.
$Cu\ O - H_2\ O = 21{,}885 - 34{,}462 = -12{,}577$,,

and yet this cell gives a pretty strong current, which, in the fluid, has the direction from lead to copper. The remainder of the paper is devoted to a theory of the voltameter, based on the following principle :—When a certain amount of polarisation is in existence, not the maximum amount, it is as if one of the platinum plates had a number of buttons of zinc partially covering its surface, so that the current from a voltaic cell when it enters the voltameter is in parallel circuit. In one path through the voltameter there is no opposing electromotive force, but by the other there is such an opposing electromotive force, and this latter becomes more and more important as time goes on. He deduces the result—

$$J = \frac{E - \frac{p}{n}}{R + r},$$

Where p is maximum polarisation, E the electromotive force of battery, r resistance of voltameter, R all other resistance of the circuit, J the current, and n a number which depends on the time decreasing from infinity to 1 with a rapidity determined by the current and the area of platinum plates. The author describes many experiments illustrating his theory—refers to Edlund's experiment showing that the heat effects produced in a voltameter are not merely those due to current resistance but also to polarisation—refers to the fact that Favre found the simple cell zinc, sulphate of zinc, platinum, to cool when it produced a current, and shows how other facts of the same kind are explainable on thermo-dynamic principles.—Abstract of a paper by M. Hoorweg in *Annalen der Physik und Chemie.—Jnl. Soc. Tel. Eng.*

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REPORT.

In the daily papers of Wednesday last the following paragraph appeared:—"A telegram from Captain R. C. Halpin to the Telegraph Construction and Maintenance Company says: 'The Seine, s., laid Placentia and St. Pierre cable yesterday at 6 p.m.'" This, of course, refers to a section of the new Atlantic cable at present being laid by the Telegraph Construction and Maintenance Company for the Anglo-American Company.

The report of the second examination of the "City and Guilds of London Institute for the Advancement of Technical Education" has been presented and adopted by the Executive Committee. It states that the results of this examination, as compared with those of the previous years, show a very considerable increase in the number of candidates, and in the number of subjects in which they were examined. In 1879, 202 candidates were examined at 23 centres in 7 subjects, of whom 151 passed; in 1880, 816 candidates were examined at 85 centres in 24 different subjects, of whom 515 passed. The towns furnishing the greatest number of candidates were Crewe, Bolton, Oldham, Kenmare, and Newcastle-on-Tyne. In 8 subjects no candidates presented themselves, viz., in fuel, glass manufacture, goldsmiths' and silversmiths' work, lace manufacture, manufacture of oils, colours, and varnishes, oils (illuminating and lubricating), printing, and sugar manufacture. Examination papers were prepared in all these subjects, but in two of them, viz., in printing and in sugar manufacture, no syllabus of requirements had been previously inserted in the programme for 1880. This may account for the fact that no candidates presented themselves in these two subjects. The total number of candidates was 816, of whom 515 passed. The following extracts from the reports of the examiners on the subjects more directly concerned with our readers may be interesting:—In electro-metallurgy, G. Gore, Esq., LL.D., F.R.S., examiner says:—"I beg to report that the technological knowledge of the subject of electro-metallurgy exhibited by the candidates was in every instance of a comparatively limited and inferior kind, not one of the candidates being able to answer the important practical question, 'How much cyanide of silver should be obtained from an ounce of silver, or an ounce of nitrate of silver?' The general scientific knowledge of the subject was also meagre. The most satisfactory parts of the papers were those relating to the details of the daily routine work of an electro-plater; some of those parts showed a practical knowledge of the subject." In telegraphy Mr. W. H. Preece, C.E., examiner, says:—"I observe in the papers a distinct advance in the character of the replies upon any previous examination that I have conducted. . . . . The telegraph operators and *employés* in this country number many thousands, and electricity is gradually being employed in some form or other in nearly every branch of trade. Hence, if properly encouraged, we must expect a very large accession in the numbers of those offering themselves for examination."

TELEGRAPHIC STATISTICS.

(FRENCH BUDGET FOR 1881.)

(CONTINUED FROM PAGE 106.)

SUBMARINE CABLE.

In addition to the information under this heading contained in our last issue, the Report states that a first cable, which has been working since Jan. 22 last, has been laid between Brest and Cape Cod, and further that the authorisation granted creates no privilege, fully reserves all State rights, and assures the gratuitous transmission of official telegrams.

PRESS ARRANGEMENTS.

The order of Nov 17, 1879, accorded a reduction of 70 per cent. upon the ordinary charges for Press despatches intended for publication and exchanged within Paris:—

1. Through any private lines that may be established, at the expense of the administrations of the journals, to connect the offices of the latter with the telegraphic posts of the Senate or of the Chamber of Deputies.

2. Through the pneumatic tubes connecting these two posts with the telegraphic station in Paris which is nearest to the administrations of the journals. This applies whether the latter be concessionaires of a private line or otherwise. The reduction does not apply to telegram cards, it relates only to those despatches which are charged per word.

This is not the only advantage that has been given to the Press. In virtue of the law of April 7, 1879, it can receive subscriptions in France and Algeria in consideration of a duty of 3 per cent. The advantage is a serious one, as may be seen from the following table, showing the results obtained from June 1, when the measure was carried into effect, up to the 15th of May last:—

Number of Orders	Amount of the Orders.	Duty of 3 per cent. yielded to the State.
158,564	1,930,129f. 21c.	59,953f. 70c.

With the object of increasing the advantage to the public, the minister proposes to substitute for the duty of 3 per cent. a duty of 1 per cent., representing the cost of transmitting the order, and a fixed duty of 10 centimes for each subscription, which is the charge for a postal card.

Treaties concluded with Belgium, Switzerland, and the Netherlands have extended the benefits of this legislation to the international relations between France and these countries. A convention with the same object in view was also concluded on April 22 last with Portugal, and another, with Italy, awaits only the signature of the contracting parties.

SCHOOLS OF TELEGRAPHY.

Thirteen schools of telegraphy were working in 1879, at Brest, Chambéry, Clermont, Ferrand, Havre, Lille, Lyon, Marseille, Montpellier, Nancy, Nantes, Nîmes, Toulon, and Toulouse.

Three new schools have been created since January 1, 1880, at Bordeaux, Dijon, and Rennes.

Paris possesses an elementary school, and also a superior school for advanced scientific instruction.

The number of pupils in the elementary schools varies from 350 to 400. The programmes are such as satisfy the requirements of the service, and, since the commencement of this year, a course of instruction in foreign languages has been added. These institutions provide excellently for the recruiting of the service.

The superior school has been carried on at Paris since 1878; it is intended for the training of the superior officers of the technical service, and principally for the inspecting and directing engineers whose duty it is to conduct the working of the service.

This school is open to all young men who have received the education necessary to enable them to follow advantageously the courses and the exercises; a certain number of appointments of pupil-engineer are made every year, after a competitive examination, accessible to all *licenciés ès sciences*, and to all the old pupils of the school of mines, bridges and roads, of the Polytechnic school, the central school, and, lastly, the normal schools for the navy and forest services. In order to render the higher grades accessible to telegraphists who have served for a certain period of time, a preparatory school, through which they may pass to the superior school, has been instituted.

The high scientific tuition given in the superior school would have been incomplete if a laboratory for demonstrations and for study had not been annexed to it. This laboratory has been organised as a workshop for trials, researches, and experiments as well as for the carrying out of improvements.

TELEGRAPHIC DISTRICTS.

From the point of view of the technical service, the territory is divided into districts and subdivisions. A decision dated Dec. 10, 1879, made some modifications in the division.

France at present comprises fifteen districts, of which the head-quarters are:—Paris (for three districts), Orleans, Rouen, Dijon, Lyon, Marseille, Montpellier, Toulouse, Bordeaux, Limoges, Clermont-Ferrand, Tours, Rennes.

Algeria constitutes a sixteenth district, of which the chief town is Algiers.

The administration considers it best, for the development and maintenance of the lines, to include a whole line, or at least a considerable fraction of a line, in one district. There is an advantage in concentrating the responsibility.

The upper staff of the technical service is at present composed of:—

16 directing engineers; 43 inspecting engineers, of whom 8 are attached to special services; 3 sub-engineers; 13 pupil engineers; 76 controllers, or persons acting as controllers, of whom 10 are attached to special services.

INTERNATIONAL SERVICES.

Under this heading it is noted that the London Telegraphic Conference resulted in seven conventions regulating the new international tariffs. These were signed by the following powers:—Italy, Great Britain, Grand Duchy of Luxembourg, Belgium, Switzerland, Spain, Portugal, and the Netherlands.

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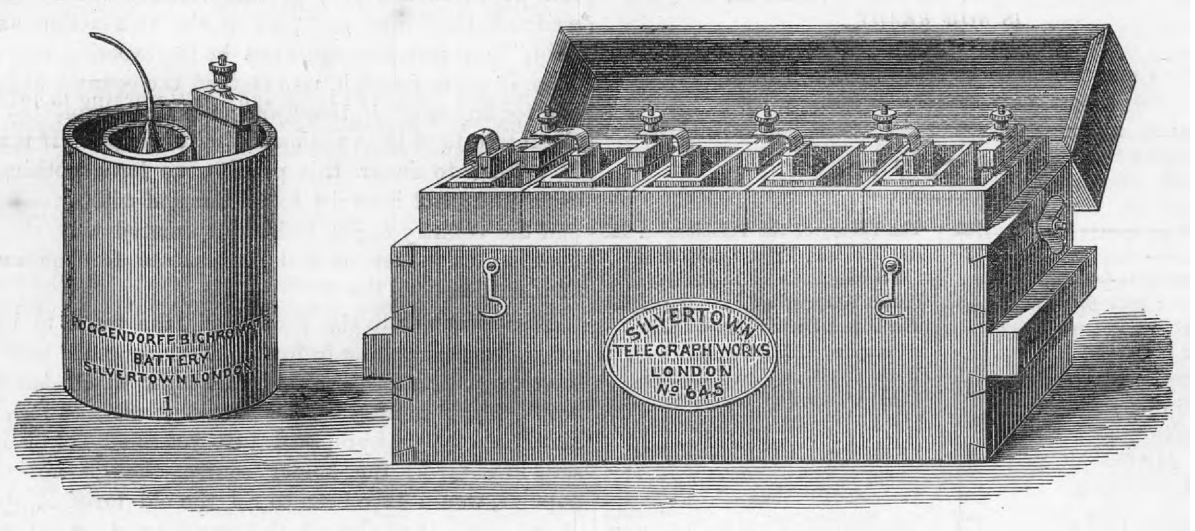
THE SILVERTOWN IMPROVED POGGENDORFF BICHROMATE BATTERY.

The makers of this battery—viz., the India Rubber, Gutta Percha, and Telegraph Works Company—claim that its electromotive force is equal to two Daniell elements, and that it is very constant and has a low internal resistance. The efficiency of the battery is due to the excellent depolarising qualities of the bichromate of potash. This efficiency the makers have greatly increased by the use of an improved bichromate compound, and by the employment of a new exciting powder which replaces sulphuric acid. The results obtained by the employment of these compounds are, it is claimed, far superior to those derived from the use of other mixtures. The handling of sulphuric acid is avoided. The battery is further improved by the careful manufacture and selection of the porous pots, and thus a battery is obtained that lasts much longer than is usually the case with a bichromate battery. The cell is composed of an outer jar of earthenware, in which are placed the carbon plate, the red compound, and water. In this earthenware jar is also placed a porous pot which contains a zinc rod, mercury, grey compound, and water. By placing the mercury (which lies at the bottom of the porous pot) round the zinc the latter is kept properly amalgamated. To charge the battery for ordinary work, one measure of mercury—the stopper of the mercury bottle forming the measure—is placed round the zinc in the porous pot and 2oz. of the grey compound. The porous pot is filled with water to within an inch of the top. In the outer jar, with the carbon plate, 8oz. of red compound are placed, and the jar filled with water to within three-quarters of an inch of the top. Should the battery be required for hard work, the porous pot should be charged with 4oz. of the grey compound instead of 2, and water added as before, and in the outer jar 12oz. of red compound should be placed instead of 8oz. By increasing the quantity of red compound the battery is rendered much more durable and efficient. When the solution in the outer jar changes to a bluish green the force of the battery will be found to have diminished considerably. It is then necessary to withdraw a portion of the solution and replace it by red compound and water. Should the solution in the porous pot change to a bluish green, half the liquid should be withdrawn and replaced by water. If crystals should form on the zinc the whole of the solution in the porous pot must be withdrawn and replaced by water and grey compound in the proportions already given, as the case may require.

The illustration shows the form of cell best adapted to general telegraph purposes.*



W. T. HENLEY AND CO.'S NEW WORKS, NORTH WOOLWICH.

It is scarcely sufficiently known that although Mr. W. T. Henley's original works at North Woolwich have, through business complications, passed out of Mr. Henley's hands and been closed, that a company, of which Mr. Henley is the managing director and principal shareholder, has now important works at North Woolwich, adjacent to the larger works. These works cover considerable ground. Two cable-making machines have been in working order for some time, and four more are in process of construction, with proper cable tanks. There are also galvanising shops, a foundry, and extensive fitting and carpenters' shops. Of the work recently made at these works we may mention thirty miles of 12 No. 8 wire cable with single conductor, and twenty miles of 10 No. 6 cable with single conductor, for the Great Northern Telegraph Company; the galvanising of 500 miles of strand of 7 No. 14 wire weighing 2,000 tons, and the supply of 500 tons of telegraph wire to the Indian Government. A number of Brush electric light machines and lamps are also being made. Mr. Henley's patent core, which we have alluded to before, is being tried by several administrations, short lengths having been ordered, and a length of ten miles has just been ordered for torpedo purposes. A length of one mile of four conductor cable to repair a cable made by Mr. Henley in 1863 is being made for the Danish Government. Mr. Henley's past connection with telegraphy has been very extensive, although it has not often been brought so prominently forward as that of others having perhaps less claim. Yet, if the history of telegraphy were accurately written, we should find that we owed much to Mr. Henley's energy, skill and perseverance, Mr. Henley may be said to have been the founder of the Magnetic Telegraph Company, as this company was projected to work Henley's magneto-telegraph, the company paying £68,000 for the patent. When the company was formed Mr. Henley resigned his directorship, and became contractor for the construction of the underground lines. In constructing the lines for this company he became perhaps the largest and earliest customer of the Gutta Percha Company (now merged into the Telegraph Construction Company) for he purchased gutta percha covered wire of that firm in 1853, and laid it underground between Manchester and Liverpool, and afterwards laid the lines underground between Manchester and London, when 2,000 miles of gutta percha-covered wire were employed. He also laid underground wires between Preston and Carlisle for the British Electric Telegraph Company, and between Dublin and Belfast (101 miles) for the Magnetic Telegraph Company.

Later on the underground wires between London and Dover, laid by the European Telegraph Company, failed, and Mr. Henley took them all up, carried them to London, repaired them, and relaid them without stopping the working of the lines, which carried the whole of the Continental traffic, as the Submarine Telegraph Company was then entirely dependent on these lines. The wires, which were previously bare, were covered by Mr. Henley with yarn and marine glue, and relaid in fresh wooden troughs.

As early as 1848 Mr. Henley insulated wires with india rubber, but began to do this on an improved plan again at his late works in 1871. The Great Northern Telegraph Company used a great quantity of this for cables, and a cable with core of this manufacture was made and laid by Mr. Henley between Chuy, on the Brazilian and Uruguay frontier, and Montevideo. Altogether, besides land stores and instruments, Mr. Henley made 13,000 miles of submarine cable at his last works.

Besides the new core which we have already alluded to Mr. Henley has patented a new type of deep sea cable. There seems no reason why the new works should not turn out a large amount of work, and we wish Mr. Henley success.

* An account of the Poggendorff battery will be found in M. Niaudet's work, and a short account in Mr. Gordon's new book, but hitherto the battery seems to have been but little used in this country.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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SIXPENNY TELEGRAMS.

It now seems more than probable that whatever virtue there may be in a sixpenny telegraph tariff will be put to the test by the present Administration. Their lot, financially speaking, has fallen in pleasant times. After ten years of real, though gradually diminishing, deficits, the revenue now rather more than pays the interest upon the capital which has been sunk in the purchase and enlargement of the Telegraph Companies' property. Just at this point a Government, pledged to and delighting in reforms of every conceivable character, comes into power; and nobody can feel surprised that the new Postmaster General has lost no time in making the most of his opportunity. It is true that he recommends still a little longer delay; but his very outspoken declarations to the Council of the Society of Arts, which waited upon him the other day, and the scheme which he recommended for their future acceptance leave no doubt that the Post Office authorities have made up their minds what course they ultimately intend to pursue.

The speech of the Postmaster General on the occasion to which we have referred bristled with subjects provocative of much and varied discussion. We shall confine ourselves mainly to two of them, namely the tariff itself, and the financial loss which its introduction will involve. As to the latter Mr. Fawcett's mode of dealing with it is peculiar, and will we should think excite more opposition than he seems to have anticipated. It is estimated that the immediate loss of revenue by reason of increased outlay and diminished receipts would, if a sixpenny rate were adopted, amount to £163,000 in the present year. It is not stated what would be the probable loss in years to come; but although a rapidly diminishing loss it would obviously be a real loss for a considerable period, and the sum of it would greatly exceed the figures just quoted. Whatever its extent, however, it would throw us back on the period of deficits but for Mr. Fawcett's exceptional view of the claim which the capital has upon the revenue for interest. If, instead of being, as it really is, ten and a half millions, the capital were only seven millions, the revenue would, not only pay interest upon it, but would easily bear the loss of the £163,000. In reality the sum paid for the Telegraphs ought to have been seven millions, says Mr. Fawcett, the odd three millions and a half being the result of a "careless bargain." If therefore the Treasury—the Chancellor of the Exchequer—can be persuaded to take this view of the situation, and write off the "careless" part of the transaction as a "bad debt," sixpenny telegrams can be forthcoming very speedily. This, in plain English, means that the country at large is to pay for an error—if there was an error—committed solely in the interests of the patrons of the telegraph. If the country is willing to incur this penalty we have nothing to say against it; but it ought to be incurred with eyes wide open, and the country ought to be well assured that the material boon to be conferred will compensate for the undeniable financial loss.

This brings us to the boon itself, the tariff to be substituted for the one now in force. Nothing could well be more wasteful and anomalous than the tariff which has long prevailed in this country for inland telegrams; and seeing that Mr. Fawcett is not prepared just yet to supersede it by the sixpenny tariff, the bolder course, though not the most popular, would have been to rid the old tariff of its grosser abuses, and thus cleared the way for a cheaper tariff. The free address system alone has all along blocked the way to any reduction in prices; and if the senders of telegrams had been frankly told that they have abused the privilege, and become a permanent charge upon the community, we have little doubt that the withdrawal of that privilege would have been cheerfully borne, and that the revenue would in this way recover itself so as to bear the loss which reduced prices will ultimately entail. As the projected new tariff ruthlessly charges for every word to be telegraphed, there seems no excuse—except a political one—for continuing to allow eight or ten words to go free. But where administrative reforms are chiefly determined by political considerations we must be content with what the see-saw of politics happens to be able to do for us.

Theoretically there is nothing to be said against the tariff which now finds favour at the Post Office. It is nominally a halfpenny per word tariff; but its minimum charge being sixpence it is practically a tariff of twelve, or any less number of words, for sixpence. A word tariff is the best of all tariffs where the price is comparatively high; but when the price is low, charging by the word is simply vexatious. Nobody begrudges the erasure which saves him twopence or three pence; but to be taxed by halfpennies for not having erased sufficiently is somewhat ignominious, and will, we predict, be felt to be inconvenient. From the sender's point of view we think that a tariff ranging from ten to twenty words, or from ten to fifteen, and then to twenty, would have been felt to be more agreeable. But something, we presume, must be sacrificed for theoretical symmetry; and thirteen

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words will therefore cost sixpence-halfpenny, while sevenpence must be the price for fourteen. There is no arguing with the votaries of theoretical perfection, so we suppose we must relegate this unexceptionably perfect scheme to the test of practical experience.

We notice with some surprise, however, that nothing was revealed as to press messages. Are the newspapers to be let off with a proportionate reduction, or are they to remain as they are? It is strange that the press, which has warmly espoused the new scheme, has not been more curious on this point. Of course it looks for its reward; but as it is most liberally treated already we do not see how it is to be conciliated without a fresh burthen to the telegraph administration, the mention of which does not occur in the estimate of loss which Mr. Fawcett detailed to his sympathetic interviewers. Perhaps they were not concerned with the special privileges which the press is seldom slow to guard for itself; and whether they were satisfied or not we are glad that the Postmaster General bluntly announced his unalterable hostility to "preference" telegrams, and also his grave objection to having one rate for towns and another for the country. We feel that these points are safe in his hands, although his arguments might be enforced with some which he did not care to make use of.

But we are not so sure that time for reflection may not reveal to the Society of Arts and others whom it may concern that the new tariff is not quite such a boon as it professes to be. Thirty words, or thereabouts, is on strict calculation rather cheaper for a shilling, than twelve words for sixpence; and if this discovery does not lead to rebellion against a twelve word maximum as being too small, it may suggest the inconvenient question why a reduction so obviously advantageous to the Government may not be introduced a little earlier. As has been pointed out by a contemporary, if payment for work actually done is the more equitable rule, why may it not be introduced at once? And it plainly comes to this, that in whatever respect the present tariff is inequitable—in other words wasteful—it ought to be remodelled without delay; or failing this the new tariff ought to displace it.

CORRESPONDENCE.

"OFF DUTY" AT P. K.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: If you and your readers are not tired of hearing about such an extramundane little place as Porthcurno, I should like to complete the sketch of P. K. life given in the excellent letters which appeared in your columns a few months ago. A short account of the life "off duty" may, perhaps, be worthy the attention of those who are interested in cable telegraphists, because that life is the foundation of a subsequent career in foreign countries, and associations formed then are frequently preserved amid the shifting scenes and laxer rules of a man's first years of foreign service.

"Let me make a nation's songs, and I care not who makes its laws," said Fletcher, and I think, Sir, you will allow that it cannot be a matter of indifference to persons interested in the future position of submarine telegraphists what are the amusements most cultivated at a station through which almost the entire staff of a large company are introduced not only to telegraphy but frequently to their first experience of an independent existence, many of the probationers being importations direct from school, with decidedly original ideas on tobacco, and other subjects. Now, Sir, a probationer who can send and receive well on the P.K. instruments, and who has developed a taste for science and mechanics, is undoubtedly a credit to the station; but a six or eight months' stay there, in order to produce thoroughly good men, should (and I hope to show *does*) give the unfledged probationer every chance of acquiring a *mens sana in corpore sano*, as well as a sound knowledge of electricity and telegraphy.

In the first place, I may safely assert that the means of recreation and the public feeling of the place are so healthy and essentially "British," that a man who is sent from P.K. to a foreign station has a liking for exercise and manly sports which should go far to keep him from sinking into any objectionable laxness; at any rate, this was so when I was a probationer there, a year or two ago.

I need not mention the splendid bathing, the grand scenery, or the extremely healthy position of the station, and the excellent arrangements made by the energetic superintendent for the comfort of his staff; you have heard of these from another correspondent, whose hand I think I recognise. But has he forgotten those glorious cricket matches, those football "scrummages," and those melodious evenings when the men in the instrument room were urged on by the soul-stirring strains—"by distance mellowed"—of the "Mulligan Guards," or "Hearts of Oak?" Doesn't he remember his trepidation when he faced the bowling of that burly yokel more swift than Spofforth or Foord-Kelcey? Surely, he can't have forgotten those "daisycutters" that, after "making earth" three-quarters of the way, came across a "fault" in the pitch and "made contact" with his eye.

We used to play matches with several of the neighbouring places, their elevens being composed of yokels, the kinetic energy of whose muscles imparted a vast momentum to the ball, which, consequently, performed a considerable number of foot-pounds of work on the batsman's person when the ground was lumpy, but I never saw a man hurt much. After these matches we used to adjourn to the hotel of the village, and you, Sir, may imagine that twenty-two men after four or five hours' hard play did some execution. After a few patriotic songs, which generally became choruses after the first verse, we drove back to the station, sometimes on an omnibus, sometimes in traps, and I can assure you, Sir, that had a lung doctor resided in those parts, one sight of that omnibus or those traps returning would have been enough to make him change his quarters.

We began cricket practice in April or May, and every morning and evening all who could be mustered off duty went to the cricket field for a couple of hours' practice, and towards the close of the season I believe the P. K. eleven would have found no difficulty in polishing off an average school eleven, though its *personnel* was constantly changing and duties necessarily interfered with the *tout ensemble*. But I always noticed that Mr. A. was anxious to promote the interests of our cricket and football clubs, if it could possibly be done without detriment to the Company's interest. When a match was on the *tapis*, he would readily change the hours of duty of any member of the eleven, so as to enable him to be present, and substitute in the instrument room one of the "awkward squad"—from a cricketer's point of view. Then, in the winter, we had football (Rugby Union), but in my time we could not always muster enough men for the orthodox game. Still, a six a-side game is not to be despised, and we generally managed to keep the ball rolling for an hour or so.

In the evening there was a great choice of amusements—the library, the billiard room, or a quiet pipe in the smoking room, unless some of the noisier spirits were experimenting on the centre of gravity of the table, or converting the room into a temporary gymnasium. But the musical section generally monopolised the messroom from about eight to eleven p.m. There were one or two men who could play the piano—one of them a Lindsay Sloper in a "nascent" state—and many a good song was sung, and encored nightly by an enthusiastic audience, who also joined in the chorus with immense effect. Our worst friends could not deny that our choruses were, literally, "stunning." I don't think card games were much patronised, but I remember taking a few hands at whist and "Nap." Of course, anything like gambling was out of the question, as the hapless probationer is, in the nature of things, in a state of chronic impecuniosity.

A rather important feature of life at P. K. was an occasional visit to Penzance. Surely there are no such dinners as those little spreads at the Union, surely nowhere do the balls run better than on the Union table. But woe to the confiding yokel who was beguiled into letting some embryo Jehu take sole charge of his trap for the journey. After the unaccustomed oats at Penzance, powerless was the 'prentice hand of the aspiring Phaethon to direct the fiery steed, and fortunate was he if a friendly hedge arrested his progress before any damage was done. But these accidents were few and far between, as the owner of the vehicle was not often to be cajoled, and, as far as I know, nothing worse ever resulted than a broken shaft and a crest-fallen coachman.

I might tell you, Sir, of the solemn conclaves in the library, when the fate of nations was decided by the political probationer,

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and of our adventures on the rugged cliffs, and in the waves of the blue Atlantic, when some incautious youth would get hopelessly fixed on an apparently inaccessible crag, or in attempting to swim ashore on a rocky coast, would emerge with bruised knees and bleeding hands. But you may imagine, Sir, that with such surroundings, we had our share of "moving accidents by flood and field."

I need only add, that if a probationer does not get on at P.K. both in knowledge and health, he must be either a prodigy of vigour and electrical science, or—very much the reverse. Every E.T.C. man I have met abroad remembers with pleasure his stay at P.K., and for my part, Sir, I am inclined to compare the place to the "Happy Valley" of a modern RASSELAS.

NEW SUBMARINE CABLES.

The India Rubber, Gutta Percha, and Telegraph Works Company have contracted to lay a cable between Marseilles and Algiers for the French Government during the present year. This will make the third cable the above firm will have made for the French Government for this route. The cable will be similar in pattern to that laid last year, the sheathing of the deep sea being 15 No. 13 homogeneous iron wires, with two tapes and compound. The length will be 500 miles of deep sea, 9 miles of intermediate and 16 miles of shore end, making a total of 525 miles, or 35 miles longer than the cable of last year. The steam ship Dacia belonging to the company is having water ballast tanks placed in her below her cable tanks. She will be employed in laying the Algiers cable. The operation of laying the cable will be conducted under the superintendence of Mr. R. K. Gray, the engineer of the company. The expedition will leave about the middle of September. A staff of French Government engineers test the cable every day at the works.

The same company are making the following cables for the Canadian Government:—Island of Anticosti to Griffins Cove, 2 miles shore end and 42 miles main cable—total, 44 miles. Prince Edward Island to the Magdalen Islands 4 miles shore end, 47 miles of main cable—total, 51 miles. Grosse Island to Bird Rocks, 4 miles shore and 15 miles main cable—total, 19 miles. Island of Grand Manin to Mainland (Maine) shore end 2 miles, main cable 9 miles—total, 11 miles, making a total of 12 miles of shore end and 113 miles of main cable.

These cables will be laid from the Dominion screw steamer Newfield, Captain Guilford. This steamer, belonging to the Dominion of Canada Government, is employed on the lighthouse and buoyage service in a similar capacity to our Trinity buoy boats. She will, however, be employed also to repair and maintain the cables, and for this purpose is being fitted at Silvertown with two iron tanks to receive the cable, and with bow and stern sheaves, with a machine for picking up and paying out cable, the one machine being constructed so as to perform both duties. Mr. F. N. Gisborne, C.E., has charge of the testing and laying of the cable and fitting of the ship on the part of the Ganadian Government.

THE SILVERTOWN PATENT LECLANCHÉ BATTERY.

(IMPROVED AGGLOMERATE CELLS.)

We are indebted to the India Rubber, Gutta Percha, and Telegraph Works Company for the following description of this battery:—The negative element of the *old* form of Leclanché cell is composed of a carbon plate placed in a mixture of coarsely-powdered peroxide of manganese and carbon, the whole contained in a porous pot. The positive element consists of a rod of amalgamated zinc. The exciting liquid is a solution of sal-ammoniac, which has no chemical action either on the zinc or on the peroxide of manganese so long as the cell is not at work. This is a great advantage, but it has been found that the cell with the porous pot offers a rather high resistance, and M. Leclanché has for some time past been experimenting with the view of decreasing it. This he has succeeded in effecting in the agglomerate form of cell by substituting movable plates for the porous pots. The depolarising plates are formed of peroxide of manganese, carbon and resin, and in course of manufacture are submitted to a pressure of several tons, and when joined to a carbon plate serving as collector, compose the negative element of the cell. To fit up the agglomerate cells, an agglomerate block is placed on each side of the carbon plate, and two india rubber bands supplied with the cell are stretched over the three to hold them together in the two places. These bands have each a solid part through which a hole has been bored to receive the zinc rod. By this means the zinc is kept from touching the negative element, thus avoiding injurious local action, and the whole is held firmly together, and is ready to be placed in the glass jar. The cell is then charged with sal-ammoniac in proportions given in the company's circular. Many advantages are claimed for the new cell with agglomerate plates, amongst which may be mentioned:—1. A much better use is made of the depolarising power of the manganese, as the reduction of it is more complete than in the porous pot form, where the manganese, while being reduced clogs, and prevents the action of the battery long before the whole of the manganese is reduced. 2. In consequence of the readier reduction of the manganese the carbon plate is more rapidly depolarised than with the porous pot form, and, consequently, the electromotive force is more sustained. 3. The resistance is *extremely constant*, whatever the electro-chemical work done by the cell may be, and will even tend to decrease in consequence of the formation of chloride of zinc, which is an excellent conductor. 4. The battery is ready for use immediately on charging, because the liquid is brought into direct contact with negative and positive elements. 5. The renewal is exceedingly simple. When the battery becomes exhausted the depolarising plates which are joined to the carbon plate have only to be removed and fresh ones substituted. 6. By avoiding the use of porous pots the risk of breakage and deterioration is very much lessened, and the cost of renewal considerably reduced.

THE THEORY OF THE TELEPHONE.

By experiments made at Toulon in 1878, M. Desportes demonstrated that sounds could be determined in a telephone under the influence of a shock produced in a bar magnet, enveloped by a magnetising coil connected to the telephone. This effect has been attributed to induced currents resulting from displacements of the bar inside the bobbin under the influence of the shock. Experiments made by M. Ader since that time have, however, shown that the phenomenon is more complicated, and, by combining several diverse experiments in order to elucidate the question, he has arrived at some interesting results, which have been recently submitted by him to the French Academy.

Firstly, he shows that if proper precautions are taken to avoid all displacement of the magnetic core inside the bobbin connected to the telephone, if, for example, one enrols the wire of the bobbin on the core itself, and stiffens the spires in shellac, no sound is obtained on striking the core with a non-magnetic body. On the other hand, the sounds may be perfectly well reproduced by striking the core with a mass of iron. It can also be reproduced if the ends of the coil thus embedded in shellac are loosely wound around the coil in two or three turns.

Again, if we place inside a small ordinary bobbin metallic cores composed of different metals, we find that only the magnetic metals, *deprived of persistent coercitive force*, provoke the telephonic sounds when struck. Thus, a wire of iron or nickel gives very characteristic effects, *whilst a wire of tempered steel, not magnetised*, produces none.

But what is most important is that these effects are the more energetic in proportion as the core is more divided in the interior of the bobbin, and the best results have been obtained when the magnetic wire was composed of ends of iron wire disposed end to end, and being only one millimetre or two millimetres long by one millimetre in diameter.

Under these conditions the telephone was made quite capable of reproducing speech very distinctly. To effect this, all that was necessary was to place under a telephone diaphragm (of about 10 centimetres diameter and $\frac{7}{20}$ millimetres thick, and furnished with a mouthpiece), a small bobbin of fine wire (No. 40) about five millimetres long, filled with the said fragments of iron wire, and to press with a suitable pressure, the external piece, which ought to be longer than the others, against the centre of the diaphragm. In speaking into the mouthpiece then, a series of vibrations are set up which, in producing a series of corresponding shocks, transmit speech in a satisfactory manner without the necessity of any battery.

The preceding apparatus permits further of proving an important fact which only complicates the question. It proves that *the displacement of the magnetic core in the heart of the bobbin does not suffice to reproduce the sounds*. It is necessary that there should be also a *shock*, and even several shocks. This may be demonstrated by soldering to the diaphragm of the apparatus a wire of iron thrust into the helix. Under these conditions the vibrations displace the iron wire, and in presence of the terrestrial magnet there ought to be developed currents capable of reproducing sounds; but none are forthcoming, and to obtain

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them it is necessary to place on the coil a second core of iron against which the first may produce shocks. In these circumstances the effects produced can be in some sort analysed by the following experiments:—

If we compress a core of iron furnished with a bobbin wound between two pieces of copper pressed between the jaws of a vice, and if the iron core is rivetted upon one of these pieces, we recognise, on suddenly raising under pressure the other piece of copper, that it produces a sound in the telephone, and this sound is doubtless due to the movement of the magnetic molecules which take their normal position of equilibrium. If we reproduce a similar mechanical action upon the core, but in a manner so as to draw instead of compressing it, we still observe a sound at the moment when the bar takes its normal conditions, and it is the same when torsion is exerted on the core. It may therefore be concluded that all mechanical action having for its consequence a disturbance of the molecular equilibrium of a magnetic core developes at the moment when this core suddenly recovers its condition of equilibrium an electric current capable of being felt on the telephone.

AN ELECTRIC TYPE COMPOSING MACHINE.

By far the most interesting of many interesting objects to be seen at the recent Printers' Exhibition at the Agricultural Hall, Islington, was the new electrical type setting machine patented by Mr. Hooker. The Clowes Type Composing Machine has neither keys nor buttons, nor does it require any manual exertion. By it the labour of the operator is reduced to a minimum. The lightest touch liberates the types, which then proceed automatically to the collecting point, and are there set up with a degree of rapidity and accuracy previously unattained. The types leave the machine in a continuous line. This must be divided by hand into shorter lines, and arranged in pages or columns. The machine will supply type sufficient to employ two persons in this process of justifying. Practically each operator will justify his own work, and the machine will keep three persons employed, turn and turn about. Several of these machines have been constantly at work at Messrs. Clowes and Sons, both at their London and country offices, for the last three years, and during part of this time type has been set up at the rate of 22,000 per hour. With a month's practice an ordinary compositor can set up easily 12,000 types per hour. Allowing for time lost in justifying, &c., experience has shown that, with the assistance of a boy to feed, the machine will complete an average of 10,000 types per hour set up in page form. It has also been found that the type can be distributed and set up in troughs by hand at a cost of less than a penny per thousand. The machine will take four sizes of type. The discharge of the types from the troughs is effected by means of a range of small electro-magnets, placed one behind each trough, and in connection with metal contact-plates, at which the compositor operates. These contact-plates are of different sizes, being, in fact, as to comparative size, shape, and arrangement, a copy of the ordinary "lower case" in use in every printing-office, and thus the trained compositor in turning to this machine has nothing new to learn, and, what is at least as important, nothing to unlearn. Before these contact-plates, as before a desk, the compositor sits and proceeds much as he is accustomed to do; only that, instead of picking out the types from the boxes of his case, he simply touches in succession the corresponding contact-plates with a wire "pointer," which he holds in his hand like a pen. The touch instantly makes the magnetic contact, and the letter is set free to go on its way to the collector. The process of touching the contact-plates may be literally as swift as thought, being limited only by the rate at which the "copy" can be mentally spelt; and to faciliate this spelling, a "sliding copy-holder" is employed, by which the line of copy which is being read is kept always at the same level, and the compositor can concentrate his attention on the copy. He thus soon becomes so used to the contact-plates, that he estimates their relative positions and distances with ease and accuracy, and touches mechanically any one he desires. The machine contains forty-eight letters, points, and spaces. These are all the types most frequently used, and to have made provision for such as are occasionally required would have unnecessarily complicated the machine and taxed the attention of the operator. A case conveniently placed at the operator's left hand contains additional capitals, figures, &c., and when one of these is wanted, he picks it out and drops it into a shoot which deposits it on the tape with hardly appreciable loss of time. For setting up a book or an article in which there will be few or no corrections this machine will prove very useful; but for ordinary newspaper work we fear it will not be so useful.

POSTAL TELEGRAPHS.

On Tuesday, in the House of Commons, Dr. Cameron rose to call attention to the report of the Select Committee of 1876 on Postal Telegraphs. The Treasury had appointed a departmental committee to consider this question. That committee recommended that the deficit should be made good by increasing the charge on such telegrams as were handed in between 8 o'clock at night and 8 o'clock in the morning, on telegrams handed in on Sunday, and on telegrams handed in at railway stations. In consequence of those recommendations the House in 1876 appointed a select committee, on which he had the honour to serve and which was presided over by the right hon. gentleman the member for the University of Edinburgh. As he had already observed, the departmental committee recommended that the loss should be made good by increasing the charges. The select committee came, however, unanimously to the decision that precisely the opposite policy ought to be adopted. A resolution was accepted by the committee to the effect that the true method of making good the deficiency which had arisen was not by increasing charges and decreasing facilities, but by increasing the facilities and at the proper time diminishing the charges. After what was said by his right hon. friend the other day, he would confine his remarks on the present occasion to the subject of sixpenny telegrams. He observed that the Telegraph Committee of 1876 enunciated a very important principle, namely, that the best means of increasing revenue was to increase the facilities for the sending of messages, and at the proper time to decrease charges. Well, since that time the carrying capacity of wires had been very much increased by the general adoption of the Wheatstone automatic instrument and the introduction of the system of duplex telegraphy. That surely was one reason why the postal telegraph authorities should reconsider their position. But that was not all. During the four years from 1872 to 1876 the increase in the revenue of the telegraphs was close upon half a million, while during the succeeding four years—namely, from 1876 to 1880—it was only £121,000. The number of messages sent during the the former period showed an increase of 7½ millions, while during the latter there was an increase of no more than six millions, inclusive of press messages. Against these suggestive facts there was only this consideration to set, that during the first period the expenditure was largely increased, while during the latter it was cut down. There was another reason why the Government should bestir themselves in the matter, and that was that we were rapidly falling behind the world in regard to the facilities for internal communication. In Paris messages could be sent for half a franc, and in Holland and Belgium even an international half-franc rate of charge had been introduced. In Paris also there was a system of pneumatic trains, as had been described in *The Times* of that day, and messages were conveyed from one end of the city to the other and a reply sent back for little more than half a franc, while in this country a shilling had to be paid for sending a single message. There was in Paris 37 pneumatic stations and nine supplementary ones; and the extent to which the service was used was such that, according to *The Times*, something like 400,000 despatches of all kinds passed over the system every month, with the certainty of a large increase when the reduced tariff had come into full operation. Now, the Postmaster-General had stated to a deputation a few days ago that he was quite prepared to adopt the charge of 6d. so far as the department was concerned, but that it was necessary to consult the Treasury on the subject. He did not, of course, know what the opinion of the Treasury might be, but nothing, he maintained, could aid so much in giving facilities to commerce as a good system of internal communication. It was stated by the right hon. gentleman that the adoption of a 6d. rate would cause a loss of only £167,000 a year, but he added that the increased profits of the Post Office for the first three months of this year amounted to £80,000, and if they went on at the same rate they would be ample to bear any loss which might result from the adoption of the 6d. scale. But be that as it might, the reform, he was sure, could not be long deferred, and he should like to call the attention of the right hon. gentleman to the report of the committee, which had made a number of suggestions as to the reorganisation of his department which were calculated to introduce greater economy into its working. Those recommendations had, however, been entirely overlooked. It was true there had been a certain amount of re-organisation, but the net result was an increase in the department. In 1866 the total staff consisted of 32 persons, and now, including the office of the controller of stores, there were 49 persons in the department. In the Engineering Department every engineer had five superintendents under him, and under each superintendent there were more than two inspectors. The result of this multiplication of persons

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was that in many cases there was a duplication, and even a triplication, of correspondence. After mentioning several recommendations of the committee which he maintained had not been attended to, the hon. member concluded by moving,—"That in the opinion of this House, the time has arrived for adopting the policy of 'increased telegraphic facilities and diminished charges' advocated by the Select Committee on Postal Telegraphs as 'the true method of making the Telegraph Department remunerative.'"

Mr. Fawcett said that his hon. friend made a somewhat serious charge against the department over which he presided. His hon. friend complained that during the four years which had elapsed since the publication of the report of the committee appointed to inquire into the telegraphic service no notice had been taken of that report, and that the recommendations contained in it had not been carried out. Having carefully read the proceedings of the committee, he wished to be among the first to offer a humble but sincere word of praise to the committee for their labours, and especially to the gentleman who presided. He joined issue at once with the hon. member for Glasgow, believing that he should be able to prove that the assertion of the hon. member that the recommendations of the committee had not been noticed by the Post Office did not rest upon a substantial basis. He would show that these recommendations had been carried out, proving his case by the best of tests—namely, the remarkable effect produced upon the postal telegraph revenue in the great increase of the receipts as compared with the increase of the working expenses. Not long after his entrance into office he had taken the recommendations of the committee to the gentlemen who presided over the the Telegraph Department and the Engineering Department, and asked them categorically whether this or that recommendation had been carried out, and in every case the answer was that the recommendation had been attended to to the extent possible in the time that had elapsed since the publication of the report. Taking the year 1876—the year when the committee reported—he found that the gross receipts from the post office were £1,287,000, and that the working expenses, including allowances for repairs and renewals, &c., were £1,097,000. The gross receipts in the four years that had since elapsed showed an increase from £1,287,000 to £1,471,000—an increase of £184,000. In the same period so great were the economies introduced that the working expenses only increased from £1,097,000 to £1,117,000. It would be seen by these figures that in the four years to which he was referring the net profits had been increased by no less a sum than £157,000 at the end of the last financial year. This increase was an increase of something like 80 per cent. After mentioning these figures it would be unnecessary for him to utter a single additional word for the purpose of showing that every one of the valuable recommendations of the committee had been carried out, and that the telegraphic department at the Post Office was being worked with great economy and with far greater efficiency than in former years. His hon. friend, the member for Glasgow, said they had done nothing in the four years since 1876. Well, he had already shown that they had increased their profits by about 80 per cent., but they had done more than this. They had increased the number of telegraph stations by 250, and the length of wires by 10,000 miles, and the progress introduced at the close at the last financial year was going on during the current year even at greater speed. His hon. friend seemed to imply that they were making no progress at the present time. Every week the returns laid before him showed the increase in telegraphic messages compared with the corresponding period last year. The increase, indeed, had been so great in the revenue that they had not been so rash, perhaps, as to suppose that this rate would continue. This increase had been no less than 16, 17, and 18 per cent., as compared with last year. The last weekly return placed in his hand showed that the increase in the number of messages in a single week, as compared with the previous year, was 91,000. This represented an increase in revenue of £4,500 a week, and if that was continued it would swell their revenue by £225,000. He wanted to state to the House what was the financial position of the telegraph system at the present time. They did not assume that the remarkable increase would continue, but they assumed that their receipts would so much increase during the present year that their profit of £354,000 would increase to £450,000; and this would show a profit of something like 4½ per cent. on the entire capital expenditure of the telegraphic service. When they remembered, to use a mild word, the carelessness with which these telegraphs were originally acquired, no one could say that the Post Office had been slow in adopting improvements or in adopting recommendations made to it by select committees of the House [hear, hear]. Then came the important question whether there ought to be a reduction in the cost of telegrams, and if there was to be a reduction in the price, what form that reduction ought to take. He had lately had occasion to give his best consideration to this question, and it seemed to him the fairest plan to adopt to make the people pay as nearly as possible in proportion to the work which was done for them. His plan was that telegrams should be charged on the word-rate, and the word-rate which he suggested was a halfpenny a word, including the address. He would have a *minimum* charge of 6d., so that no message would cost less than that sum; and all words above 12 would be charged a half-penny each. They must consider the effect of this change on the Exchequer, and this was a question with which the Chancellor of the Exchequer and the Treasury only had to do; but it seemed to him that the lessening of the taxation on internal communications was one of those questions which demanded early attention the moment the Exchequer was in a position to deal with the matter. He was sure the House would see that the question was one which rested with the Chancellor of the Exchequer and the other authorities of the Treasury. There was no disinclination on the part of the Post Office officials whatever to accept a reduction of the cost of telegrams. He left the question in the hands of the House and the Chancellor of the Exchequer, and he could only say there was no one in the country who would more rejoice than himself if the day had arrived in the finances of the country when it should be considered safe and prudent to make a sacrifice of £167,000 revenue and give what he felt as strongly as his hon. friend the member for Glasgow would be a great boon to the public—cheap telegrams.

Mr. Givan said that he did not doubt the sincerity of the right hon. gentleman and his desire to do all that he could to reduce the price of telegraphic communication throughout the country. But there was a strong feeling throughout all parts of the United Kingdom that the charge for telegraphic messages should be lowered. He did not think such an increase as was mentioned by the Postmaster-General in the Post Office staff would be necessary. In nearly all rural districts no increase would be necessary. In many places the postmaster and his assistants had scarcely anything to do all day, and certainly in such places no increase of expense need be incurred.

The motion was then, by leave, withdrawn.

On Wednesday Mr. Fawcett said, as a very considerable interest was taken in the question of conveying messages by telegraph and by pneumatic tube, he trusted the House would give him permission to correct a statement made by the hon. member for Glasgow last night—a statement which he was sure his hon. friend would be glad to have corrected. His hon. friend said there were 37 stations in Paris for the conveyance of messages by pneumatic tube, and that the number of messages conveyed by the pneumatic trains was 400,000 every month. This figure had been taken from *The Times*, but there had been a misprint, and the real number was 40,000; therefore, the number was not one-third as many as the messages sent in London. He thought it important to make this correction, and he had further to state, that, considering the importance of conveying messages by pneumatic tube, he should take steps in the recess to have a perfectly impartial inquiry made on the subject in Paris and Berlin.

[A full account of the Parisian system will be found in our issue of July 17, p. 105.—Ed. *E.*]

DIRECT UNITED STATES CABLE COMPANY (LIMITED).

The sixth ordinary general meeting of the above Company was held on the 29th inst., at the City Terminus Hotel, under the presidency of Mr. John Pender, M.P.

The Secretary read the notice convening the meeting, and the report of the directors, which appeared in *The Electrician* of last week, was taken as read.

The Chairman moved the following resolution:—"That the report of the directors, dated 16th July, 1880, together with the statement of accounts to the 30th June, 1880, annexed thereto, be, and the same are hereby, received and adopted, and that a final dividend be now declared of five shillings per share, free of income tax, making with the interim dividends already paid a total dividend of 5 per cent. for the year ending 30th June, 1880." In doing so he said that, as shown by the Company's accounts, the revenue for the half year to the 30th June last, after deducting out-payments, amounted to £82,149. The working expenses, interest on debentures, income tax, and other payments, absorbed £22,863, leaving a balance of £59,285 as net profit for the half year, making, with £15,677 brought forward from the previous half year, a total of £74,963, which had been appropriated as follows:—Interim dividend of 5s. per share, 31st March last, £15,177 10s.; a final dividend of like amount now proposed, £15,177 10s. Carried to the reserve fund £22,847 (which now amounted to £175,000), and carried forward £21,760. Owing to the reduced tariffs in operation over the Direct and the Anglo-American lines, the revenue for the half year would afford no reliable comparison with that earned in the same period of last year. It was satisfactory, however, to find that the falling off was not so large as was expected. Looking to the expenditure, it would be seen that in London, notwithstanding the large item for printing and stationery, their expenses were less than in any previous half year, with the exception of the June half of 1878. In comparing

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the stations' expenditure they must not forget that for nearly three months in the early part of last year their main cable was broken, and during this interruption their disbursements at stations were very much under the average, whereas in this half year, owing to continuous working, and the changes of tariff, an increase in some items, particularly for printing, &c., had been unavoidable. The increase of £383 in salaries and messengers' wages, and £347 in rents, rates, and taxes, were entirely due to the opening of two new stations; and the increases of £473 in maintenance, £477 in printing, £60 in stamps, and £96 in bank commission were due to continuous working this year. The remaining items of the stations' disbursements were about the same as at that time last year. The expenditure in Canada was incurred in promoting legislation in the Dominion. On the whole (excluding the interest on debentures), in only one half year since the formation of the Company had the total ordinary expenditure been so low as it was at present. He hoped that the next six months' working would be as satisfactory as the last; but, as they were aware, they were now actively engaged in competition with the new French Company—a competition which, if injurious to the Direct Company, must be more disastrous to the French Company. The Direct Company had a reserve fund upon which they could draw to maintain their dividends, but he hoped now that the French cable was in working order, and that the Board had had some experience in the traffic, that wiser counsels would prevail with them, and that before long some arrangement would be come to which would prevent the great loss to this Company, and the far more disastrous loss to the French Company. When he last addressed them six months ago he went fully into details, not only as to the position of this Company, but also as to the formation of the French Company. He stated then that he had told the syndicate in Paris that before twelve months had passed their shares would be at something like 50 per cent. discount. That had been realised, because he believed they had touched very nearly 50 per cent. discount, and if the competition went on for any length of time there was no doubt that they would go to a still greater discount. Having so fully explained matters at the last meeting, and as he believed that at the present moment the best policy he could pursue was to say very little about the French Company or about the competition, he thought that looking to the enormous interests at stake it would be wrong for him to say anything that would embitter their relations with the French Company. He should rather acknowledge the French Company as an existing company, and if they saw their way, having gathered some experience from the working of their system, to approach this company in any such spirit as they could see would result satisfactorily, they were not likely to turn their backs on them. The promotors of the new company, very much as in the case of the Direct Company, had, he believed, suffered very seriously. If the syndicate still held their shares, they held them at a price very different from what they paid for them. There was, therefore, nothing further to say on the point. When the moment came that an end could be put to the competition at present existing, the directors would not be backward in bringing it to a close, for at the moment it was very disastrous to all concerned. He then concluded by moving the resolution.

Mr. WILLIAM FORD having seconded the motion,

Mr. GUESDON said that the Chairman had foreshadowed a diminution of the reserve fund by the competition. He, however, looked to the fund as a very important element in the solidity of all companies, and he hoped that the directors would carefully consider matters before they touched the reserve fund. This was a speculative Company, and he held that the shareholders in such companies had no right to expect continuous dividends. The great number of the shares were not held at £20 each, but at a very much smaller price, and, therefore, if they got the Consol rate of interest as dividend they would be receiving a very handsome return on their investment. He hoped that the reserve fund would be maintained as a fund on which they could fall back in the event of any great emergency, but not to be touched in order to continue the present rate of dividend.

Mr. JACKSON cordially acquiesced in the remarks of the previous speaker. Let them go without a dividend if necessary, but certainly let them not diminish that which was the backbone of the Company. They must remember that theirs was a single cable, and eventualities might arise which would be disastrous to the Company if their reserve fund were dwindled away. It was the sheet anchor of the Company.

The CHAIRMAN said he was delighted to see gentlemen rise up in the body of the room and stand up for the reserve fund. No one stood up for that fund more than he, and no one would be more sorry to part with a shilling of it; but when they made up their minds to fight, they must show that they had cannon as well as powder. He wanted to show, if necessary, and if they must fight, that they had the means; but, on the other hand, he sincerely hoped they would not part with a farthing of the reserve fund, although according to their articles of association the very first use of the reserve fund was to be applied to equalising dividends. They were, therefore, not going beyond the powers they possessed. He held at the same time that it was very desirable that they should keep their reserve fund intact. He was more a man of peace than to urge fighting, and had always advocated the policy of conciliation in regard to these matters, and the policy of arrangements being come to to prevent the shareholders from loss. He hoped, too, in this case that some arrangement would be arrived at which would be equitable and fair to all parties, and that that time would come before any necessity arose to touch their reserve fund.

A SHAREHOLDER pointed out that there were 60,695 shares, whereas the dividend was apparently paid on fifteen more than that number.

The CHAIRMAN said that they were held for a shareholder who had not claimed his interest in the liquidation, and they were obliged to provide for that. He then put the motion, and it was carried unanimously. Continuing, he moved the following resolution:—"That the Board of Directors be and are hereby authorised to make and carry into effect and, if they think fit, from time to time alter and vary arrangements for assisting the *employés* of the Company in effecting insurances upon their lives, and for this purpose to pay out of the revenues of the Company such sums as they may from time to time deem expedient, not exceeding in any case one-half of the premiums required, and not exceeding £1,000 per annum." In asking them to support that resolution he was only asking them to follow the course which some of the leading telegraph companies had already adopted. He supported it upon two grounds, first because he thought it was most desirable that the Company should have ready and willing hands in their employ, and that their *employés* should not feel that there were other companies where they might be better treated than in the service of this Company. It was also very important that in a Company like theirs they should have not only intelligent men, but men of honour, because there were very important secrets entrusted to them. They required in short a very superior class of operatives to carry on the mechanical part of their business. The nature of the business was very trying, and this was another reason why the resolution should be supported. The eyesight was apt to fail, and early, because the work required great attention on the part of the operator, and was a great strain on the eye and a considerable strain on the brain. Then, further, they sent their young men to very out-of-the-way places. He thought these were grounds on which they were bound to show their *employés* that they took a deep interest in all concerning them. What they were offering now was a very small percentage indeed on their dividend, and he thought that the good will and what he would call the loyalty of their young men would give an ample return for a very small price. He believed they would all agree in the importance of making their young men feel happy and contented.

Mr. UNDERDOWN, in seconding the motion, confirmed every word which the Chairman had said. He had had very great experience in the employment of men in foreign countries, and in positions of trust similar to those in this Company. In such cases as these he held that a duty was cast on the employers to do something for the persons in their service, and he believed that such a measure as that which was now proposed would secure to them the benefit which the Chairman had pointed out. It was of the very highest importance in a Company like theirs that the staff should be united, contented, and at all times ready to do good service. If that was to be obtained at the small price mentioned he doubted very much whether any very strong reason could be held out against it. He believed it was a measure which would commend itself to every one. He sincerely trusted that the shareholders would accept the recommendation of the Board, and enable them to place at the disposition of the *employés* of the Company the small sum mentioned in order to secure the benefit of insurance.

Mr. GUESDON contended that life policies of the ordinary character were attended with great inconveniences, some of which he pointed out, and observed that it would be a different thing if they were themselves going to undertake their insurance. He suggested that the matter be deferred for further consideration. He did not oppose the motion on the ground of the amount, but because he wished the most careful consideration to be given to the subject. By deferring the question, they might decide on what was the best course to be adopted, and bring the matter before the shareholders at the next meeting.

The CHAIRMAN said he was very glad to find that the hon. shareholder did not object to the principle of the proposal, but only to the details. The very principle advocated by Mr. Guesdon was more or less embodied in the proposal. The insurances would be effected up to 50, and if a man left at the age of 50 he could retire on the amount he received; if he died before attaining that age it would go to the benefit of his family, and if he left the employ of the Company it would be a question of arrangement between the Board and the *employé*. The whole of the objection raised had really been met by the manner in which the Board had dealt with the subject.

Mr. WILLIAM ABBOTT said the Chairman, from his long connection with submarine telegraphs, must have had experience of the particular cases that were likely to come on the fund. The £1,000 was simply infinitesimal, having regard to their capital of £1,300,000 and their yearly income of £200,000, and he hoped the resolution would be passed unanimously, leaving the Board to administer the sum mentioned as they might think fit.

After a few observations from Mr. VEARES in support of the proposal,

The CHAIRMAN said that the subject was discussed at a meeting of the Anglo-American Company, and was adjourned for a very good reason—to consider it; but it so happened that one was a sort of believer that a shareholder in one telegraph company was a shareholder in others, and as the question was so thoroughly thrashed out at meetings of the Anglo-American, the Eastern, and Eastern Extension Companies, he had not said more about it at the present meeting. If an *employé* was dismissed or resigned, it was a matter of arrangement with him and the insurance company; but one of the great features of the proposal was this, that it bound a young man very much to the Company, and its tendency was to secure a better class of young men in their employ.

Mr. GUESDON urged that it should be made a mutual life insurance.

Mr. UNDERDOWN said that this could not be done. The staff was not large enough.

The CHAIRMAN then put the motion, and it was carried *nem con.*

On the motion of the CHAIRMAN, seconded by Admiral R. C. MAYNE, C.B., Mr. Ford was re-elected to his seat at the Board, as was Mr. C. J. Günther, on the motion of the CHAIRMAN, seconded by Lord HAWKE.

Mr. FORD, in acknowledgment, thanked them on behalf of Mr. Günther and himself for the renewal of the confidence which the shareholders placed in them by electing them directors three years ago. Up to 1877 the shareholders had not received any return upon the capital they had invested in the Company for the three years previously, while during the three years the present Board had been in office they had had the satisfaction of distributing among the shareholders no less than £182,130 in dividends, and the still greater satisfaction of placing to the reserve fund the not inconsiderable sum of £175,000, in addition to which they had a sum in hand of about £22,000. His trust and confidence was that if he should live to seek re-election in three years' time the Board would be enabled to show the same result as they had shown that day.

Mr. JACKSON moved the re-election of the auditors, Messrs. J. G. Griffiths, F.C.A., and Joseph Sawyer, F.C.A. In doing so he expressed satisfaction at the character of the investments.

A SHAREHOLDER, who said he was a member of the Stock Exchange, seconded the motion, but did not regard as satisfactory the investments in Chatham and Dover and North British Railway stocks.

Mr. ABBOTT, on the other hand, strongly advised them to retain their interest in the Chatham and Dover Preference Stock.

The CHAIRMAN said the Board looked closely as to what was the best investment, and there was never any difference of opinion as to the security being of the first order. There was not one of their investments which they could not sell out at a profit.

The motion was then carried unanimously.

A hearty vote of thanks to the Chairman and Directors was proposed and seconded and carried unanimously.

The CHAIRMAN, in reply, said the Board could have no greater reward

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than the approval of the shareholders. He really thought he could say without hesitation that the Company occupied a very good position indeed as compared with the time when they were fighting. There was still a little work to be done, and he hoped it would be done in a way that would meet with the approval of the shareholders.

The proceedings then terminated.

THE INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS COMPANY (LIMITED).

The half-yearly general meeting of the Company will be held at the Cannon-street Hotel, in the city of London, on Thursday, the 5th August, at twelve o'clock noon, for the purpose of obtaining the sanction of the Company to the payment of an interim dividend. The register of transfers of the Company's shares will be closed from the 29th inst. to the 5th prox., both days included. The report of the Company states that, after deducting the usual depreciation on buildings and machinery, the net profit made by the Company in the six months ending 30th ult. is, subject to audit, £20,150. Of this sum the directors propose to distribute an interim dividend for the half year of 10s. per share, free of income tax, being at the rate of 10 per cent. per annum, payable on the 6th August. This will absorb £15,600, and leave £4,550 to be added to the £4,278 brought forward on 31st December last, making the balance now to be carried forward £8,828.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).

The report of the Directors is issued with accounts of the Company for the year ending December 31, 1879, showing the gross revenue to be £26,530 9s. 0d., and the expenditure £32,293 9s. 11d., including £11,768 for payment of debenture interest, leaving a balance of £5,763 0s. 11d. to the debit of revenue account. As the shareholders are already aware, the falling off in the traffic receipts is due to the war between Chili and Peru, the following sections having been cut by the Chilian war vessels, viz.:—Antofagasta—Iquique, Iquique—Arica, Arica—Mollendo, Mollendo—Chorrillos. The Company's steamer has been prevented from obtaining employment in water carrying, owing to the war; her earnings during the past year were as follows:—Salvage, £1,636 6s. 7d.; freight, £1,030 14s. 5d.; towage, £52 17s. 3d.—total, £2,719 18s. 3d. Every kind of cable work required has been successfully undertaken by the steamer, and her adaptability for salvage purposes fully proved.

ABSTRACT OF PATENTS.

4549. INSULATED ELECTRIC CONDUCTORS, *J. Bell.—Dated 8th November*, 1879. 6*d*.

Asbestos or amianthus paper is wrapped spirally or otherwise around the metallic conductor, and secured by an adhesive substance. The asbestos and amianthus may also be applied in a pulp or the fibre plaited round the conductor. The conductors thus constructed are coated with silicate of soda or other agent to bind the whole and withstand moisture.

4573. ELECTRIC TELEGRAPH APPARATUS, *C. D. Abel.—Dated 10th November*, 1879.—(*A communication.*) 8*d*.

This relates to the construction of type-printing apparatus for dial electric telegraph receiving instruments, wherein a type wheel actuated by a crank handle is moved in accordance with the index actuated from the distant station and situated on the same letter dial as the said crank handle, the impression of the corresponding types being effected by the lateral motion or shifting of a ring or wheel-shaped part, when the crank handle is made to mark the divisions at which the index stops.

4593. ELECTRICAL SIGNAL OR INDICATOR APPARATUS, *W. Moseley.—Dated 11th November*, 1879. 6*d*.

This relates to electrical signal or indicator apparatus, chiefly designed to be used in connection with an electric bell, the purpose of the apparatus being to indicate from what room or apartment the bell has been rung, or to convey signals of various kinds.

TRAFFIC RECEIPTS FOR JUNE, 1880.

COMPANIES.	June, 1880.	June, 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,700 estd.	2,425	275	—
Direct Spanish Telegraph Company	1,277 estd.	1,025	252	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	—	—	—	—
Eastern Extension Telegraph Company	29,100	26,485	2,615	—
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES JULY 28.		BUSINESS DONE WEEK ENDING JULY 28. Highest.	Lowest.
Anglo-American Ordinary	62¾,	63	62¾	62¼
Do. "B"	92¼,	¾	93⅛	92¼
Do. "A"	35¼,	¾	36	35½
Brazilian	8 11-16,	13-16	8⅞	8⅝
Cuba	10,	⅛	10⅜	10⅛
Do. Ten per Cent. Pref.	16½,	17½	—	—
Direct Spanish	1⅜,	2¼	—	—
Do. Ten per Cent. Preference	11¼,	¾	11⅜	11⅛
Direct United States	12,	¼	12¼	11⅞
Eastern	9⅜,	½	9 9-16	9⅜
Do. Six per Cent. Debenture	103,	106	—	—
Do. Five per Cent. do. 1899	104,	107	105	105
Do. Six p Ct. Preference	12⅜,	⅝	12⅝	12¼
Eastern Extension	9 7-16,	9-16	9 9-16	9 7-16
Do. Six per Cent. Deb.	108,	111	—	—
German Union	9,	½	9⅜	9⅛
Globe Telegraph & Trust	6½,	⅝	6 11-16	6½
Do. Six p Ct. Preference	12⅜,	½	12¼	12¼
Great Northern	9⅜,	⅝	9⅝	9½
Indo-European	23½,	24½	23⅞	23⅞
Mediterranean Extension	2⅜,	3⅛	3	2⅞
Do. Eight per Cent. Preference	10⅜,	11	—	—
Reuter's	9½,	10⅜	—	—
Submarine	247,	253	—	—
West India and Panama	1 9-16,	11-16	1¾	1½
Do. Six per Cent. 1st Preference	7⅛,	⅜	7½	7½
Western and Brazilian	6⅜,	¾	6¾	6 9-16
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	—	—

ADDRESSES.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
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Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

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Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

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Specialities—Morses, Polarised Relays, Saunders' Curb Keys, Type Printers, Recording Sounders, Duplex Apparatus (Theiler's Patent).

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Proprietors of the Gramme Patent Machine for alternate currents.
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R. C. ANDERSON'S PATENT BATTERIES, Powerful, Constant, and suitable for all purposes.
Electricians and Engineers are invited to view them in action daily from 3 p.m.
Prices and full particulars post free.
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SLIP

THE ATLANTIC CABLE COMPANIES.—We believe that negotiations between the rival companies have been successful in bringing about an amicable working arrangement.

COOL, BUT NOT CONSIDERATE.—A fortnightly contemporary still continues to fill its columns with matter extracted from *The Electrician*, but it forgets to acknowledge the source of its information.

THE CALABRIA.—The ss. "Calabria," belonging to the Telegraph Construction and Maintenance Company, is now in dock, having returned from the East, after successfully laying the Hong Kong-Manilla cable.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—The Direct United States Cable Company notify that the scrip certificates of their Six per Cent Debenture Loan may now be exchanged for debentures at the company's offices, 52, Old Broad-street, London, E.C.

THE ELECTRIC LIGHT IN HANOVER.—After several trials, the electric light has been definitively adopted for the illumination of the railway station in the town of Hanover. Eight lamps are employed; being worked by the steam engines located in the goods department.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).—The number of messages passing over the lines of this company during the month of July was 2,478, estimated to produce £2,800, against 2,504 messages, producing £2,932 in the corresponding month of last year. The traffic receipts for the month of May, estimated at £2,900, realised £2,972.

A DEFUNCT ELECTRICAL JOURNAL.—We regret to hear that our contemporary *The Electro-Metallurgist and Electrical Light Journal* has ceased to exist; the number for June being the last issue. The paper was started in January of the present year, and has contained information of considerable interest and value in the direction of electro-deposition, and in relation to the precious metals.

ELECTRIC RAILWAYS.—The firm of Siemens and Halske has laid before the municipality of Berlin a new project for the establishment of electric railways in that town. They propose that all the railway termini in Berlin, and the stations of the metropolitan railway, should be placed in communication by the electrical railway. It is proposed also that a line should be constructed from the Skalitzerstrasse to the terminus of the metropolitan railway and to the Zoological gardens, passing by the stations of Potsdam and Anhalt, and that a second line should be laid between the Brandeburg gate and Charlottemburg.

THE ELECTRIC LIGHT IN PARIS FOR THE FETE OF JULY 14.—On this occasion nearly all the inventors of apparatus and the companies for electric lighting were represented. About forty Jablochkoff candles were arranged in groups at the Bois de Boulogne; four lamps of M. Lontin were placed on the July column at the Place de la Bastille, and six more on the boulevard Montparnasse; the Serrin lamp was conspicuous on the Place de la Republique, and at the *Mairie du Temple*, whilst the modification of this lamp by M. Suisse was to be seen burning in the open air at the rue Sedaine; six Jamin lamps illuminated the *Magazins réunis*, and others were observed in Belleville; Messrs. Siemens Brothers had fourteen of their differential lamps at the *Palais Royal*, and four on the *place de la Bourse;* the *loggia* of the Opera was illuminated by six Duboscq regulators; the Compagnie Meritens and the Société Werderman had been active at various points; whilst the Société Générale d'Electricité was very conspicuous at *Notre Dame*, the Luxembourg, the Trocadero, the Pantheon and elsewhere.

THE TELEPHONE.—A motion was made on Thursday morning, July 29, before Vice-Chancellor Malins, to restrain the United Telephone Company from issuing advertisements stating that they were taking proceedings against Mr. Louis J. Crossley, of Halifax, for infringement of their patent for carbon transmitters, pending legal proceedings which Mr. Crossley invited the company to take against him for infringement of the patent. The company are assignees of the Edison patent, and the day after the registration of assignment commenced proceedings against various parties. Mr. Crossley contended that his carbon transmitter, the "compound microphone," was no infringement of the Edison patent assigned to the company. After a short discussion the defendant company undertook not to issue the advertisements complained of, without prejudice to any question of the propriety of the proceedings which had been taken. Mr. Aston, Q.C., Mr. Philbrick, Q.C., and Mr. Macrory, instructed by Messrs. Philbrick and Corpe, 18, Austin Friars, appeared for the plaintiff; and Mr. Glasse, Q.C., and Mr. Cozens Hardy, instructed by Messrs. Waterhouse and Winterbottom, of Lincoln's-inn, appeared for the defendants.

THE BRITISH ASSOCIATION.—On the 25th of this month the President-elect, Professor A. L. Ramsey, LL.D., F.R.S., will deliver his inaugural address to the fiftieth meeting of the British Association, to be held at Swansea. Unfortunately, the meeting of the Iron and Steel Institute is to be held at Düsseldorf during the same week, and many eminent scientific men have signified their intention of being in Germany who would otherwise probably have attended the British Association at Swansea. The last meeting at Swansea was in 1848, under the presidency of the Marquis of Northampton, V.P.R.S. The papers read in 1848 were many of them on subjects concerning electrical science. We may here briefly mention the papers and the authors, and refer to the subject again in a future number. The papers were:—"On a New Magnetic Action," by Herr Plücker; "Variations of the Force and the Direction of Terrestrial Magnetism which Seem to Depend on the Aurora Borealis," by Dr. Siljeström; "The Equilibrium of Magnetic or Diamagnetic Bodies of any Form under the Influence of the Terrestrial Magnetic Force," by Prof. W. now Sir W. Thomson; and one on "The Theory of Electro-Magnetic Induction," by the same author; "The Electric Telegraph Subservient to Meteorological Research," by J. Ball; "A General Law of Electrical Discharge," by Sir W. Snow Harris; "Notices of Aurora observed at Swansea," by Mr. J. Jenkins; "On the Motion of the Electric Fluid along Conductors," by the Rev. T. Exley; "The Identity of the Existences in Forces of Light, Heat, Electricity, Magnetism, and Gravitation," by Mr. J. Goodman; "On a Galvanometer; also, On the Electromotive Force;" "Dynamic Effect and Resistance of Various Voltaic Combinations," by Mr. W. I. Ward; "On Subaqueous Rope for Telegraphic and Other Purposes;" also on the "Uniformity of Time, and Other Telegraphs;" also "On the Telekouphon, or, Speaking Telegraph," by Mr. F. Whishaw.

OIL TANKS FIRED BY LIGHTNING.—Thunderstorms in America have from time time caused enormous damage to the oil wells, and for some time a controversy has been carried on as to the actual manner in which the oil is ignited. The *Scientific American*, speaking on this matter, says:—"On the 14th of July a terrible storm, with thunder and

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lightning, passed over the neighbourhood of Bradford, Pa., and, as usual, quite a number of oil tanks were struck and their contents burned. Property to the amount of half a million dollars is reported as having been destroyed. One stroke of lightning fired a 25,000 bbl. iron tank, full of oil, at Custer City, near Bradford, belonging to the United Pipe Lines. Another large tank at Kansas Branch was struck and burned. Tank 367, containing 25,000 bbls., on Lewis Run was also struck and burned. At Coleville a 250 bbl. tank was struck and burned, the flames spreading to other tanks. At Kendall Creek two wells were struck and 600 bbls. oil consumed. At Sawyer City a well was struck and 250 bbls. oil destroyed. At Red Rock two oil rigs and 100 bbls. oil were struck and burned. The burning oil from the Custer City tank spread to adjoining tanks, and great destruction of property ensued. This is a sad catalogue for one storm. We recently called attention to the remarkable fact that lightning seems to make a special selection of oil tanks as objects for destruction. Almost every thunderstorm that sweeps over the Pennsylvania oil regions sets oil in a blaze somewhere; but up to the present time no observation seems to have shown exactly how these conflagrations are induced or what the remedy is. We have heretofore presented two theories: 1. That the light hydro-carbon vapours from the oil, rising high in the air above the tank, form a conductor which the lightning follows into the tank and ignites the gas. 2. That the lightning strikes or is discharged from the iron supply pipe of the tank, at a greater or less distance from the latter, whereby a spark is induced within the tank, between the supply pipe and the iron casing of the tank. The most minute spark of electricity thus appearing in the tank would set fire to the oil, as the end of the supply pipe terminates above the oil, in an atmosphere of highly inflammable gas. If this theory is correct, and it looks reasonable, one remedy would consist in making an electrical connection between the oil supply pipe and the iron casing of the tank. This can readily be done by means of half a dozen short pieces of wires, or strips of copper, the respective ends of the copper being soldered to the outside of the iron casing of the tank and to the exterior of the supply pipe. It might be supposed that if the iron supply pipe is in contact with the iron casing of the pipe, no further connection would be necessary, which is very true. But if there is rust, or a film of oil, between the pipe and the casing, then the contact would not be perfect, a spark might result, and the gas be set on fire. We therefore advise tank owners to make use of soldered connections, done in the most thorough manner as we have indicated. It is alleged that the use of lightning rods, arranged on masts near the oil tanks, has proved ineffectual. But we have seen no particulars of the manner in which such rods are grounded. If their terminals were simply stuck down a few feet into dry earth—which is the way most of the good-for nothing rods are arranged—then of course no protection could be expected. If their terminals were soldered to iron underground pipes which were directly connected with the tanks, the protection might be secured. The value of any lightning rod as a protector chiefly depends upon its being well grounded, or in other words thoroughly connected with the earth. One of the best groundings for a lightning rod is an iron water or gas pipe, which extends for a long distance underground, and thus affords an extensive conducting surface between the rod and the earth. The bottom of the rod should be soldered to such iron pipe."

On Boltzman's Method for Determining the Velocity of an Electric Current. By E. H. Hall.—In the June number of Silliman's Journal is mentioned a note relative to the velocity of electricity, published by Professor Boltzman in the *Kaiserliche Akademie der Wissenchafen in Wien*, January 15th, 1880. In this note Professor Boltzman points out a method by which, as he thinks, the absolute velocity of current-electricity may be determined from the results furnished by the study of a phenomenon lately described in Silliman's Journal under the title "A New Action of the Magnet on Electric Currents." Quite recently there has appeared in the *Kaiserl. Akad.* an account of experiments and calculations made by Albert v. Ettingshausen, whereby he deduces for the electrical current sent by "one or two Daniell cells" through his strip of gold the velocity 1·2 millim. per second. Unless I have misunderstood Professor Boltzman's note, however, there is a fatal objection to the fundamental assumption which he makes. I will give very briefly his method of reasoning, as I understand it. We know, as Professor Boltzman says, that a conductor bearing a current is acted upon by a force tending to move it in a direction at right angles to the direction of the magnetic force acting upon it. We know, moreover, from the new phenomenon, that there is at the same time a difference of potential set up between points on opposite sides of the conductor, and that the electromotive force thus arising is in the same line as the above force acting upon the conductor. Consider now any particle of electricity in the conductor. It is acted upon by the newly-discovered transverse force, tends to move accordingly, and tends to draw the conductor with it. Imagine enough particles of electricity crowded into the conductor, and we have the explanation of the familiar action between magnets and conductors bearing currents. Knowing, therefore, the strength of our magnetic field, the strength of the primary current, and the consequent difference of potential on opposite sides of the conductor, we can calculate exactly the amount of electricity contained in unit length of the conductor at any moment while the current is flowing. Knowing, moreover, the amount of electricity passing through the conductor in unit of time, which quantity is of course what we call the strength of the current, it is a perfectly simple matter to determine the velocity of the current. This question meanwhile presents itself:—If the very slight difference of potential existing between opposite sides of the conductor is sufficient, when acting upon the electricity contained within the conductor, to cause the strong action which every one has observed between magnets and conductors bearing currents, why is there not an enormously greater force always acting upon the conductor in the direction of the primary electromotive force and primary current? To get a more definite view of the matter, suppose we send through a strip of gold leaf, a centimetre wide and of any length, a current of strength ·05 (cm.-grm.-sec.), and place the strip in a magnetic field of strength 4,000. A certain difference of potential would now be observed between points opposite each other on the edges of the strip. This difference of potential, E′, would, in the case imagined, be perhaps 1-3000 the difference of potential, E, for two points a centimetre apart in the line of the main current. Now the force acting upon a unit length of the conductor to move it across the lines of magnetic force would be $4000 \times \cdot 05 = 200$ dynes. This force everybody knows to exist. Let us suppose for the moment, with Professor Boltzman, that it is due to the difference of potential E′ acting upon the electricity in the conductor. But now we have the difference of potential E 3,000 times as great as E′, acting upon the same electricity, but acting in the direction of the current. To be consistent, therefore, we must

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look for a force in this direction equal to $3{,}000 \times 200 = 600{,}000$ dynes, a force equal to the weight of about 600 grams, acting upon each unit length of the gold-leaf strip. Thus, in following out Professor Boltzman's assumption to what seems to me its necessary consequences, we are led to a manifest absurdity. Another objection to the above assumption, and a serious one apparently, is found in a fact not known to Professor Boltzman when his note was written. The transverse electromotive force in iron is opposite in direction to that in gold. According to the theory proposed, therefore, an iron wire bearing a current should move across the lines of magnetic force in a direction contrary to that followed by wires of other materials, which it does not do. In view of these difficulties it seems hardly possible at present to accept Professor Boltzman's method of calculating the velocity of electricity. Any one desiring to see Professor Boltzman's note will find a translation of the same in the *Philosophical Magazine* of April, 1880, p. 307. A rather confusing inaccuracy in translation is, however, to be found about the middle of page 308, in the sentence, "Hence, if the force above denoted by *k itself* acts upon," &c. This should read, "Hence, if the force above denoted by *k* acts upon the movable electricity *itself* in the gold-leaf," &c. The position of the pronoun is here a matter of considerable importance, as any one will see who reads Prof. Boltzman's note with care.—Silliman's *American Journal*, July, 1880.

Fire Alarms.—The extended use of electric fire alarms is only a question of time. It is true, however, that the English mind is far too Conservative in ordinary cases to act before compelled to do so. Fire insurance companies will, perhaps, find it to their interest to insert a clause in the policy, or, better, to insure at a lower rate, provided buildings are automatically protected by alarum. As we have so often pointed out, a fire is at our mercy only at its commencement, and what we want is to know when and where it commences. On this subject Mr. J. F. H. Woodward writes an interesting letter to the *Miller*. He says:—"I have the pleasure to inform you that 'Bright's Electric Fire Alarm' is now being fitted in the North Shore Mills, Liverpool (one of the largest in England), and will be completed this week, the directors of this Milling Company being convinced of the great value of this application of electricity in giving almost instantaneous warning of any outbreak of fire, and thereby enabling the workmen to at once bring their appliances for extinguishing the fire to bear, before the fire has had a chance of making any headway. I may mention that the alarm has been erected over the large works of the India Rubber and Gutta Percha Company, at Silvertown, and in the block of buildings at 100 to 106, Cannon-street, London, for some months past, and whenever tested has been found in perfect working order. It has also been adopted by the Metropolitan Board of Works for a considerable portion of the streets in the city and Southwark, so that the police constables or the public can instantly signal any outbreak of fire they may discover to the different fire-engine stations. To enable Mr. Bright to get an approximate idea of those classes of property in which his alarm would be of the most value, I have, for the past twelve months, kept a record of all the fires I have noticed in the public press from July, 1879, to July, 1880, and a statistical account of the same I have now the pleasure to hand you, which I shall be obliged by your publishing. I would here remark that only nine flour mills came under my personal notice as having been on fire, though I have been informed that fires have occurred in a great many more. It is, however, a significant fact that out of the nine five were *totally* destroyed, and one nearly totally destroyed, the remaining three being more or less damaged. On the other statistics you will doubtless make your own comments, but I cannot close this without alluding to the large number of fires—viz., sixty-eight, that occurred in warehouses where goods only were stored, and, unless there were a good deal of spontaneous combustion in the goods warehoused, I cannot but conclude that there must have been the most reckless carelessness in the use of lights by those in charge of the warehouses, or that several of them have been set on fire by incendiaries, as sixty-eight fires taking place in warehouses, out of a total of 400 in all other classes of buildings put together, are out of all proportion to what they should be. The proportion of fires in private houses—118—is also large, but this is traceable to three principal causes—viz., badly constructed flues, the use of paraffin lamps and the general carelessness of servants. It is painful to have to remark that in these 400 fires 56 persons were burnt to death or died afterwards from the injuries received, and 59 were more or less seriously injured. In most of these cases the fires occurred in the night, and from the want of some system of warning in the houses to at once arouse the inhabitants their lives were sacrificed, as their chances of escape were cut off by the progress the fire had made before they were aware of its existence; and it is in preventing such lamentable accidents as these that the 'Bright's Electric Fire Alarm' becomes invaluable, to say nothing of the saving of property by a fire being discovered and put out at its commencement. In looking over my list I find the following noblemen's and gentlemen's residences were either destroyed or injured by fire in 1879 and 1880:—Sir Stafford Northcote's, The Pynes, Exeter; Yarrow House, Norwood; Marden House, near Caterham, belonging to Sir William Clayton; Park Hall, near Alcester, Lord Yarmouth's; Quarr Wood House, near Ryde; High Grove, near Pinner, Sir Hume Campbell's; South Cliff, near Scarborough, Colonel Inglis's. This fire was discovered by Lady Sheffield at 3 a.m., and a very valuable library was destroyed. Earl of Galloway's, Upper Grosvenor-street; Sir Vernon Harcourt's, Grafton-street; and Blackmore Park, Worcestershire, the residence of Gandolphi Hornihold, Esq., was totally destroyed.

Statistics of 400 Fires between July, 1879, and July, 1880.

Corn and Flour Mills	9	Private Residences	118
Cotton Mills	15	Shops	38
Rice and Spice Mills	2		400
Saw Mills	11		
Factories of all descriptions	75		
Warehouses where goods only are stored	68	Cases in which cause of fire was known	85
Hotels, Coffee and Public Houses	22	Cases in which cause of fire was unknown	159
Brewery	1	No explanation given	156
Distillery	2		
Town Halls	3	Fires occurred in day	71
Colleges	1	,, ,, night	237
Banks	1	Not stated	92
Cathedrals	1		
Churches	3	Persons burnt to death or died from injuries received in the foregoing fires	56
Chapels	3	Persons injured	56
Post Offices	2		
Lunatic Asylums	1	Buildings completely destroyed	94
Railway Stations	8	Buildings partly destroyed	306
School Houses	3		
Tower of London	1	Value of property destroyed in which the loss was ascertained in 66 out of the 400 fires	£1,539,710."
Barracks	1		
Police Stations	1		
Dockyard Workshops	1		
Theatres	4		
Prisons	1		
Hospitals	1		
Club Houses	2		
Union Workhouses	1		

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SUCCESSFUL CABLE GRAPPLING IN 2,000 FATHOMS.

It is an exceedingly agreeable duty to record probably the most successful operation in cable grappling that has as yet occurred in the history of submarine telegraphy. The operation in deep water is a formidable one at all times, and although greater experience and better apparatus have so frequently conduced to success since those memorable attempts from August 1 to August 11, in the year 1865, it is a task not to be lightly undertaken. The grapplings in the Atlantic have shown the bed of this ocean to be extremely irregular, and to this irregularity and the destructive wearing action on cables, added to the destructive chemical action in some parts, may be attributed the generally received idea that the life of a cable is limited to about ten years. The perseverance and the success of the Eastern Telegraph Company have conclusively shown, however, that a cable in deep water may be perfectly sound after ten years submersion. In 1870 a cable was laid off the coast of Portugal, belonging to this company's system. Three successive efforts have been made to raise this cable from a depth of over 2,000 fathoms, and we are informed that the small steamship "Chiltern," belonging to the Eastern Company, under the command of Captain Goodsall, has just succeeded in effecting the operation. The electrician in charge of the expedition was Mr. C. H. Phillips, of the Eastern Telegraph Company's staff, late chief officer of the Telegraph Construction and Maintenance Company's steamship "Scotia."

It may be too soon to draw conclusions from the results of this operation, but at any rate cable companies will no longer believe in the *laissez faire* system when a fault appears in a cable of a moderate age. We have spoken above of two enemies to a cable, viz., an uneven sea bed, and chemical action. It may be taken for granted that oceanic water is never in a state of perfect rest, and the result of motion acting on a cable on an uneven bottom must be disastrous. The strain on a cable weakened by such action, and picked up from great depths, is too great, and the cable breaks. When, however, the bed is fairly level, the action is much less destructive, and, as has been shown in the case just recorded, the cable may be fully equal to bearing the strain of raising, even after so long a time as ten years. Of late years, and principally by reason of the requirements of cable telegraphy, much has been done to explore the ocean bed, but the work should be continued without cessation. This, indeed, is a matter more directly for the consideration of governments. It cannot be expected that private enterprise should accomplish everything at its own risk when, perhaps, the greatest gainers by the success of the enterprise will be the government. Many of the men who witnessed the failure of 1865 are still working in the field of cable telegraphy, and their voices have been consistently assuring us that all requirements for successful cable work would and could be fully supplied by science.

The grappling with and bringing to the surface a cable ten years old from a depth of 2,000 fathoms will amply justify them in all they have said, and it is to be hoped that in the future pessimists who know little of the work except from newspapers will acknowledge the value of practical experience. We consider that this success is one of the greatest triumphs achieved in cable work.

THE TELEPHONE BRINGS AN INTERPRETER.—A correspondent sends us a Swansea paper, containing an account of how an interpretation came by telephone. It seems that the agent at Swansea having undertaken to erect a telephone line for the Corporation advertised for poles. A Welshman, with poles to sell, called to strike a bargain, but on attempting business it was found that the Welshman knew nothing of English, and the agent nothing of Welsh. The common word was "telephone." The agent thought for a moment, and then walking to a telephone called to a friend at the other end of the line, who could understand Welsh. His friend conversed with the Welshman, translated the conversation to the agent, facilitated business, and made that plain which seemed so difficult

ELECTRO-TELEDYNAMICS.

BY PAGET HIGGS, LL.D., ASSOC. MEM. I.C.E.

Teledynamics, or the science of transmission of power to a distance, has been confined in meaning to the conveyance of power by belting, or by ropes and pulleys. The transmissions of power by tubes of water, or of air, have neither, as far as I know, received specific titles. Whilst using the general term teledynamics in its commonly accepted and limited sense, I propose to name that correlative science in which electricity appears as the transmitting medium, as in the title of this paper; and, consistently, to term the science of hydraulic means of power-transmission, hydro-teledynamics; and that in which air is employed, pneuma-teledynamics. These titles would convey the desired meanings, and prevent unnecessary repetition.

The employment of compressed air as a means of transmitting motive power has, in the last decade, received so great an advance as to become a chief tool in tunnel construction, and an important aid in mining and quarrying. The system, with its numerous defects, proves the want of power-transmission possessing greater facilities than the merely mechanical teledynamic method. Notwithstanding the loss of power through the heat manifested in the air during compression, to which must be added the loss by cold manifested during the expansion of the air, as well as the incidental losses due to effects of extraneous temperature, this system is being much extended in its application. The power transmitted by air is, to put it electrically, of low tension; the velocity of the current is affected in high degree by the walls of the pipe, and the engines, generative and motor, are bulky. For some of these reasons, the efficiency or the ratio of power received to that transmitted is low, rarely more than 30 per cent., and in practice averaging 25 per cent.

Hydraulic transmission has been limited in its application. Probably this has occurred from the great pressure in the pipes conveying the power, varying from 100 to 700lb. a square inch, from the difficulty of maintaining the pipes intact under this pressure, but chiefly from the slowness and indocile nature of the power received. For cranes and elevators hydraulic power has been and is transferred and accumulated with great economy; its generation at high tension is, however, expensive in first cost of plant.

To the third means of transmitting power by the intervention of electricity but desultory attention has been given, and very little is publicly known on the subject, whilst as a mechanical method both in adaptation and efficiency it can leave only small margin for complaint. It may, therefore, be not inadvisable to study more closely the advantages that electricity gives over water and air as transmission media.

In 1878 I presented to the Institution of Civil Engineers a paper, which was afterwards incorporated, with an account of other experiments, into book* form, descriptive of a series of measurements of power received and transmitted. I then showed that the efficiency of power received to that transmitted was one-half, provided regard was had to the maximum power obtainable from the second or receiving machine. This proviso, although stated, was given with insufficient definiteness, and the related ratios of efficiency were disregarded, making it appear as though 50 per cent. were the maximum relative efficiency. That this is not the case will presently be made clear.

In the system of transmission referred to similar dynamo-electric machines were employed, one being connected to a steam or water motor, from which power was initially derived to generate electricity in this the transmitting machine. The electricity so obtained was conducted by a cable of copper wire to a second or receiving machine, from which power was taken and observed on a dynamometer. This is the primitive arrangement for the machines in transmission by electricity, the electrical circuit comprising the exciting magnets and the revolving armature and the conducting wire in direct connection. Such an arrangement, although admitting of considerable facility for mathematical investigation is emphatically not the practically best, neither in the machines themselves, nor in their connection to the line-wire and related dimensions. The mathematical representation is, however, of the utmost simplicity under this system, and serves as a step in the study of complex and more efficient methods, such as the use of shunt magnet circuits on the Wheatstone principle, subjects of subsequent consideration.

It is now common knowledge that the revolving coils of the second machine generate a current, the electromotive force of which is of contrary sign to that of the current from the first machine. In this, the first machine represents a battery, the second a decomposing cell, and, for the electrical conditions of the circuit, we have, as current, the quotient of the difference of the electromotive forces by the sum of the resist-

* "The Electric Transmission of Power." [E. and F. N. Spon.]

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ances, or $\frac{E - e}{R + r + \rho}$, where E is the primary electromotive force, e the secondary, and R and r the resistances corresponding to the generators, ρ being that of the connecting wires. From Wheatstone's first elucidation of this formulated expression of polarisation phenomena to the present time innumerable investigators have considered the corresponding mechanical or heat values of the electrical conditions of any part of such circuit. It would remain only to see how these apply to the subject in hand; but that it is convenient to give one definite representation of such a deduction.

In an electric circuit comprised of the resistances R, R_1, R_2, &c., there may exist the electromotive forces $\pm E$, $\pm E_1$, $\pm E_2$, &c., and Q may be taken to represent the resultant current produced. The work of the electromotive forces will be represented by $\pm E Q$, $\pm E_1 Q$, $\pm E_2 Q$, &c., and the thermic value of the current passing in each of the resistances will be $Q^2 R$, $Q^2 R_1$, $Q^2 R_2$, &c. The sum of the terms of the latter series will be strictly equal to that of the former, although corresponding terms may differ greatly. To correspond with the earlier representation, three terms of the series may be taken to correspond to R, r, and ρ, and in the last portion of the circuit or in the conductor the electromotive force of the third term may be assumed to be nil. There then occurs the equation (substituting e for E_1)

$$Q E - Q e = Q^2 (R + r + \rho), \text{ or}$$
$$Q E = Q e + Q^2 (R + r + \rho);$$

or, putting for $(E - e)$ the letter V and for $(R + r + \rho)$ the letter S,

$$Q E = \frac{V}{S} E + \frac{V}{S} e + \frac{V^2}{S} \quad . \quad . \quad . \quad . \quad . \quad (1).$$

The first term is the total work of the source, the second the work of the motor, the third the thermic work lost in heating the wires. These expressions may be taken as in absolute units, and assigned their proper co-efficients for reduction to the ordinary units of work, tension, current, resistance, and heat.

If $e = 0$, the thermic or lost work is at a maximum; if $e = E$, the thermic work disappears. The variable value of e is a true representation of the state of the second machine or the motor which is at rest when $e = 0$. Between these two limits there is an algebraic maximum, when $e = \frac{E}{2}$, and when there is an equal distribution between thermic work and the motor's work. As the variable e exceeds $\frac{E}{2}$, the motor's work diminishes in absolute value, but increases in value relatively to the work expended, to the limit $e = E$. This absolute value of work reclaimed is obviously determined, in relation to the work expended, by the ratio $\frac{e}{E}$, and its relation to its maximum is $= 4 \frac{e}{E} \left(1 - \frac{e}{E}\right)$.

Thus, if the electromotive force of the generator be a fixed quantity, the relative efficiency cannot be increased beyond $\frac{1}{2}$ without diminishing the absolute value of the work reclaimed; for any fixed relative efficiency the work reclaimed can be increased to any given value, provided the generator's electromotive force can also be increased, as when absorbing a fixed mechanical power. Only under this condition can the work reclaimed, at the theoretical limit, equal the work expended.

These two cases, apparently incompatible, are not really so, and the inconsistency disappears on a close study of the question, which is not generally well understood. Its solution, as here given, unerringly points out to the constructor the principle to be followed in building machines for the transmission of power.

(TO BE CONTINUED.)

ATMOSPHERIC ELECTRICITY.

Notwithstanding numerous researches, some of which already date a century back, the laws by which atmospheric electricity varies, are not yet established. Nevertheless, a knowledge of these laws is the first step towards the understanding of the true cause of this important phenomenon. A valuable contribution to the subject has just been made by M. Mascart, and communicated to the French Academy.

The apparatus employed by him consists of a Thomson quadrant electrometer, in which the movements of the needle are transmitted by mechanical means to a pencil which draws lines on a band of paper at very close intervals. Both pairs of quadrants are maintained at equal potentials and contrary signs by the poles of a battery, whose middle plate is connected to earth, and the needle is in connection with an insulated vessel which allows a jet of water to flow into the outer air. In short, the needle is connected to the well-known "water-dropping collector" of Sir William Thomson's design.

This arrangement presents the advantage that the deviations of the needle are equal on both sides of zero for changes of equal and contrary sign. The angular displacement of the needle is small enough under ordinary circumstances to remain sensibly proportional to the potential of the needle, that is, to the potential of the air at the point where the vein of water issuing from the vessel breaks into drops.

The curves then obtained have not the continuity which belongs to most other meteorological observations, and they often present sudden variations ranging from one end to another of the scale within a few minutes of time.

The examination of these curves, from the point of view of accidental changes, confirms a number of facts already known. The potential of the air is generally positive, particularly when the sky is pure. In cloudy weather the potential diminishes, shows rapid changes in degree, and is occasionally negative in kind. Rain almost always gives great negative deviations. The approach of a storm betrays itself oftenest by a great negative variation, followed by oscillations of great extent in the two directions, with a marked predominance of negative potentials. Positive rains are extremely rare, and never occur without storms.

It is manifest that accidental variations, great and little, ought not to enter into the reckoning if it is desired to find the normal course of the phenomenon. The simple appearance of the graphic lines on the paper permits of this course being readily seen; and the mean of a number of observations can be readily determined.

The phenomena observed by M. Mascart since January last are in agreement with the results obtained by him last year. The apparatus is installed at the College of France, that is to say, in the heart of a great city, and it might be objected that different results would be obtained in the open country. But M. Mascart affirms, on the strength of numerous experiments, that, save in the case of great perturbations, the seat of active electric masses is very far distant from the surface of the soil, and it is probable that the influence of a city does not cause much disturbance on the daily course of atmospheric electricity.

In its mean condition, the potential of the air, always positive, is much more elevated, and more uniform by night than by day. From nine in the evening to three in the morning it varies little. It lowers at sunrise, takes a minimum value at three p.m., rises rapidly afterwards, and attains a maximum about nine p.m.

There is thus only one minimum during the day and one maximum, almost constant during a great part of the night. That is to say, there is only one daily period, at least when we consider the most important term of the phenomenon. The amplitude of daily oscillation is notably more feeble during winter. The exceptional cold of December, 1879, would have had peculiar interest in connection with M. Mascart's experiments; but, unfortunately, the precautions taken against the freezing of the water in the collector did not prove sufficient to prevent congelation.

M. Mascart is of opinion that there is a relation between the electric state of the air and the temperature, but it will be necessary to possess several years' observations to establish that relation with rigour, and to study all the details of it.

The existence of the maximum of the night is in disaccord with the rule generally adopted. It is generally believed, since the experiment of M. Quetelet on the subject at Brussels, that there exists two daily maxima of atmospheric electricity, one in the morning and one in the evening, as well as two minima, one in the day and the other in the night. If M. Mascart's results are to be relied upon, this discordance would seem to be due to the method of observation adopted by M. Quetelet, unless, indeed, there are two maxima and two minima per day at Brussels.

M. Mascart's direct observations were made by day, and the nightly minimum inferred from them without being directly observed. But this minimum has been observed by other experimenters, either directly or by means of registering apparatus.

One cause of error which M. Mascart deems too frequently neglected is the insulation of the apparatus. An electrometer electrified by a temporary influence, and put in communication with water-dropping apparatus, only falls short by an unknown fraction, sometimes very slight, of the potential that it ought to have were the loss by the supports neglectable. But the insulating power of ordinary supports, stems of glass for example, varies much with the conditions of the atmosphere, and several courses combine to augment their conductivity during the night. It is necessary, therefore, to employ supports having an insulating power as perfect as possible and independent of all atmospheric conditions. Such a source of leakage may account for many misconceptions in similar researches.

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INVESTMENT.

According to the table compiled by Mr. Lewis Wells, F.S.S., as given in our issue of June 12, the number of miles of cable belonging to the British Submarine Cable Companies, in December, 1879, was nearly 65,500 miles, brought into existence by the expenditure of a capital of £25,344,554. The revenue derived from this mileage is given as about £2,400,000, or rather more than £37 per mile; but on an examination it will be seen that the revenue from 3,845 miles of cable is put as *nil*, because no report had at the time of compilation been issued from the new Company owning this cable. Otherwise we might, with some plausibility, say the average receipts per mile reached £40. There is no doubt this is under rather than over the mark. Leaving out of question the new company, the table shows dividends on ordinary capital varying from 18 per cent. to, in four cases, *nil*. Seventeen companies altogether are mentioned, and in nine cases the dividend is five per cent. or higher, in three cases less than five, and, as previously mentioned, in four cases *nil*. It is exceedingly difficult in some of these cases to say why no dividend has been paid, one case showing a revenue of nearly £37 per mile, but probably some exceptional repairs ran away with what would otherwise have gone into the pockets of the shareholders. On the whole, however, it must be granted that submarine cable property is in a flourishing condition. Perhaps this may be shown more clearly by taking a few typical cases. At the present moment the Anglo-American and the Direct United States Cable Companies are in the midst of a keen competition with a new rival. In our issue for August 3, 1878, the shares of the Anglo-American are quoted for the previous week as realising from $61\frac{3}{8}$ to $62\frac{1}{8}$, in our last issue the quotations were from $62\frac{1}{4}$ to $62\frac{7}{8}$, showing actually a decided advance even with the competition—the Direct showing on comparison of the same periods a slight decline. The shares of the Eastern Company, which in 1878 were quoted at $7\frac{7}{8}$ to 7 11-16, are now quoted from $9\frac{3}{8}$ to 9 9-16, and we are asked if they will not reach par. The Eastern Extension show a similar rise in value, and it must be remembered we are here speaking of the ordinary and not of Preference Shares or Debenture Stock.

We have been led to call attention to these facts by the remarkable speech of the chairman at the meeting of the Globe Telegraph and Trust Company held on July 30. This Company is not to be classed among the speculative companies. It is, on the contrary, founded on sound business principles, and supported on the whole by small investors—investors who wish to receive a moderately fair and constant dividend for their investment. The Company owns no lines and runs few risks. It holds largely in various companies, upon the principle that all cannot go wrong together, and that on the whole there must necessarily be a tendency to equalise the per centage received. Let us give an example. A has £100 to invest. He may invest it in company B, C, D, *ad libitum*. Suppose he risks it in B. It may prove profitable or it may not. If B is a cable company an exceptional series of faults may render the per centage of that particular undertaking *nil*. On the contrary, suppose A risks his £100 in a trust company. The company invests not only in B shares, but in C shares, D shares, &c., and thus the probability is that if B fails, C and D do not, or if C fails at any particular time B and D do not, and so the probability is that the investor, although he may not get so high a per centage, will get a more equable one, and be far less likely to realise what is meant by *nil* in the report so far as it concerns dividends. That the public are beginning to realise and appreciate the advantages of belonging to a trust company will be seen from the statement of Mr. Pender, that the Globe Telegraph and Trust Company had on the 18th July, 1873, 1,777 shareholders; on 18th July, 1874, 2,744 shareholders; on 18th July, 1875, 3,164 shareholders; on 18th July, 1876, 3,651 shareholders; on 18th July, 1877, 4,204 shareholders; on 18th July, 1878, 4,400 shareholders; on 18th July, 1879, 4,480 shareholders; and on 18th July, 1880, we find that there were 5,461 shareholders. So far the increase has been very marked, in fact, during the past year there has been an increase of over 900 additional shareholders. The appreciation of the public might also be shown by comparing the quotations, as has previously been done in other cases; thus, in our issue on August 3, 1878, Globe Telegraph and Trust Shares were quoted 5 7-16 to 5 13-16, Six per Cent. Preference from 11 to $11\frac{1}{8}$; while in our last issue Ordinary Shares are quoted $6\frac{1}{4}$ to 6 11-16, Six per Cent. Preference $12\frac{1}{4}$ to $12\frac{1}{2}$, and a careful perusal of the report will show that Mr. Pender was justified in saying "The security enjoyed by the preference shareholders is so strong that I am not at all astonished to see the position which the preference shares occupy in the market at the present time; in fact, looking to the difficulty of investing money, I doubt very much if there is a better or sounder security than Globe Preference Shares at the present moment." Of course the existing competition between

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the Atlantic lines reflects to some extent on holders in this Company, but it is far from being a vital question. It is by no means probable that the whole revenue of the English Atlantic Companies will be absorbed in the fight, it is far more probable that some arrangements will almost immediately be made. Hence we trust the supposititious case of the Atlantic Companies' dividends being *nil* presented by the chairman will never become a real case.

We have, then, briefly shown that cable property is increasing in value, that a company like the Globe Telegraph and Trust Company is non speculative, and gives the average instead of the individual dividend, thereby incurring less risk and greater certainty of continuous payments. Although we have so far mentioned only one Trust Company, our remarks do not necessarily apply to this alone; in fact, there was held on the same day the meeting of another Company—the Submarine Cables Trust—the report of which was very satisfactory. These reports will shadow forth to intending investors the exact position of such Companies, and no doubt will be found full of valuable information to many who have not hitherto devoted much attention to Companies of this character.

THE TELEGRAPHIC CABLE ACROSS THE CASPIAN SEA.*

Manufacture, Transport, and Submersion.

The eastern coast of the Caspian Sea, where the Russian regiments and colonies of Krasnovodsk are located, was without any telegraphic communication with the Caucasus, notwithstanding that the Transcaucasian military administration is subordinated to the superior administration of the Caucasus.

The continued increase, especially within the last few years, of the intercourse with Krasnovodsk caused the necessity for establishing direct communication to be more and more felt. This being the case, the superior administration of the Caucasus, which for several years past had been considering the question of connecting the transcaucasian military circle with the opposite shore by means of a submarine cable, thought it expedient to hasten the solution of this question, so that the proposed connection might be effected that same year.

Terminal stations having been selected in the direction of Bakou (east coast) and Krasnovodsk (west coast), the carrying out of the undertaking was entrusted to the Telegraph Department, and was to be completed before the autumn, at which season the tempestuous weather might have prevented any operations in this direction.

The distance between the locality for laying and that of the manufacture, together with the difficulties of transport across the continent, rendered the conditions of contract difficult to draw up. Thus, in order to gain time, it was considered necessary to draft the same without waiting for special data, and simply on information obtained from the map of the Caspain sea brought out by the hydrographic department. The calculation of the length of the cable, which was to serve as a basis for estimating the total cost of the undertaking, preceded therefore the selection of a definite line for the laying of the cable.

To determine the direction of this line, whilst bearing in mind the usual precautions, that is to say whilst avoiding dangerous localities, precipitous rocks and sea-bottoms, where the cable might be exposed to a destructive action, and, at the same time, seeking the shortest route, it was decided to take the peninsula of Apchéron, near Cape Gourgane, where the anchoring of the fleet would not injure the cable, as the starting-point in laying. The line, taking thence a direction towards the eastern coast of the Caspian Sea, was to lie in the same latitude as Krasnovodsk, leaving to the north the island of Gelavo, and the *naphtha rocks*, and to pass at some distance from the submarine ridge which divides the Caspian sea into two basins.

The length, as the crow flies, of the line thus indicated is 125 nautical miles (of 1,852 metres). It was provided that there should be an additional 16 miles of reserve cable to meet various contingencies. The total length of cable to be ordered was thus 141 nautical miles. There remained to be specified the construction of the cable and the deviations to be made in laying it. It was necessary not to lose sight of the importance of this line in time of war, the difficulty of repairing it, and the impossibility of counting upon the assistance of special vessels; and it was important to make the cable of great strength throughout its whole length, but especially near the coasts, to enable it to stand the ground swell which is so frequent in this locality. Two types of cable were therefore determined upon—one for the coast and shore ends, and the other for deep-water cable.

The following were the conditions for the construction:—

The metallic sheathing was to consist of ten galvanised iron wires of diameters (*a*) 7·6 millimetres or 297 *mils*, *i.e.*, No. 1 of the Birmingham wire gauge, for the shore-ends; and (*b*) 5·2 millimetres or 208 *mils*, *i.e.*, No. 6 B.W.G., for the deep-sea cable. Each sheathing wire was to be of strength sufficient to support 42 kilog. per square millimeter, and the sheathing was to be coated with two layers of tarred hemp.

The lengths of cable ordered were 24 naut. miles of shore-end, and 117 of deep-sea cable; forming a total of 141 naut. miles, inclusive of the reserve cable.

The measures, diameters, construction, &c., which were indicated by the telegraph department corresponded to those which the French Government had selected for the Corsica cable laid in 1878; and it was resolved to adopt as a basis, generally, the electrical conditions established by the French administration.

The outer diameter of the insulating sheath was fixed at 7 millim. or 275 *mils*; the weight of gutta-percha being not less than 63 kilog., or 138·8lb. English, per naut. mile.

The conductor (*l'âme*)* consists of a stand formed of 7 copper wires, ·7 mm. in diameter, twisted in such manner that one of the wires is central throughout the whole length. The diameter of the strand is not less than 2·2mm. or 86 mils.; its weight is 48 kilog. per mile.

The electrical resistance of the conductor, at the temperature of 24° C., is not higher than 12 ohms† (12·28 Siemens' units).

The inductive or electrostatic capacity of the core is not greater than ·4 microfarad per naut. mile.

The battery employed for testing the insulation has a minimum electromotive force of 100 Daniell cells.

Since the Caspian sea, during 3 or 4 months in the year, presents a very low temperature, the minimum insulation was to be 600 megohms per naut. mile, no temperature being specified.

The conditions of the construction of the cable being laid down, there remained to be considered the questions of manufacturing, transporting and laying the cable. The difficulties in the way of carrying out, by the agency of its own staff, the two operations of transport and laying, necessitating special appliances, induced the Department to entrust the whole of the operations to a single firm, which, in addition to the pecuniary guarantee specified in the conditions of contract, should be considered competent to carry out the three operations of manufacture, transport and laying, and to assume, consequently, the entire responsibility.

In accordance with these considerations, conditions of contract were drawn up on the above-mentioned basis, and on March 24, 1879, were communicated to all the foreign cable manufacturers, as well as to persons known to have been specially engaged in similar enterprises. The contract was submitted to public tender on April 24 following. The major portion of the firms offered their services for the manufacture of the cable, but regretted that they could not undertake the transport to so great a distance across the Continent. Thus two competitors were alone in presence, viz.:—Dr. Siemens, of Berlin, and M. Palliesen, the representative in Russia of the great company of northern telegraphs. They offered to take the whole contract, the former for £62,000, and the latter for £59,500; this contractor stating that the cable would be manufactured at the works of the India Rubber and Gutta Percha Company, near London. The undertaking was therefore awarded to M. Palliesen.

On its part, the Department of Telegraphs had sent out a principal mechanician and several functionaries to study finally and theoretically the questions involved. Their labours allowed of a route for the line being definitively determined. Starting from the Peninsular of Apchéron, and passing about six miles to the south of the island of Gelaro and of the naptha rocks, the cable was to be laid to the town of Krasnovodsk itself, on the opposite shore. By reason of this modification of the route, the cable was to be 147 miles in length, inclusive of the reserve, being composed of 24 miles of shore-end, and 123 of deep sea cable, or an increase of six miles above the length originally estimated.

The manufacture at the works was superintended by several electricians sent by the contractor and belonging to the great company of the North. These electricians were to take note day by day of the work done. On the other hand, the Imperial Department of Telegraphs was represented in London by an Inspec-

* Translated from the *Journal Télégraphique*.

* The word is here improperly used; the expression *l'âme du cable* corresponding to the English term *core of the cable*.—Ed *E*.

† *Per knot*.—Ed. *E*.

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tor-General of the Telegraphs of the empire, who was to supervise the work.

At the same period the same firm was constructing the cable ordered by the French Government for laying between Algeria and the Continent; and, the Telegraphic Congress being then at London, its members were invited to visit the works and take cognisance of the materials employed.

The work having been completed on June 19, 1879, experiments were made at London on the 23rd of the same month, showing that the cable was in every respect in conformity with the stipulations of the contract, and the results of these experiments were duly placed on record.

The ultimate success of the undertaking mainly depended on the steps that would be taken to effect the transport of the cable. From London to Cronstadt, the transport was effected by the "Great Northern," a steamer tolerably well-known as being specially constructed for this kind of operation. The total weight of the cable was 660·6 tons. With a view to secure as much as possible all the conditions conducive to success, and to avoid frequent transhipments and exposure to the open air, which are productive of a detrimental effect observable at a later period when the remedy would be difficult and costly, and at the same time in order to arrange that the experiments which had commenced on the first day of manufacture should be continued until the cable was actually being worked, six barges, of very slight draught and of dimensions adapted to narrow canals and locks, had been specially ordered. These barges were of ascertained strength to resist the currents of the rivers Cheksna and Svir and the force of the wind, as well as the rapids and waves of the Volga, and of the open roadstead from Astrakan to Beroutchi-Kosa, on the Caspian Sea. Five of them, each with a tank placed parallel with the sides, were made for the reception of the cable. Two apertures, a little below the water line, and capable of being closed or opened, served to introduce water into the tank; whilst at the bottom, communicating with the hold and with a pump-cylinder, was the aperture for emptying the tank. The cable was to be coiled round an interior partition of oval form. By means of these precautions the cable could be kept continuously submerged. On each barge cabins to contain the necessary apparatus for the daily tests had been erected astern, together with accommodation for the engineers and electricians sent out by the contractor. The prow was decked in order to provide a ward-room for the sailors.

A sixth barge was reserved for the transport of materials and of the necessary appliances. It contained the kitchen and the common-room. The transport through rivers and canals to the shores of the Caspian sea appeared therefore to be well provided for.

The same difficulties presented themselves in regard to the selection of a vessel adapted for the transport of the cable from the estuary of the Volga to the peninsula of Apchéron, and for the laying of the cable from that point. The most convenient plan would have been to employ a large steam-vessel capable of taking the whole cable; but no ship of this description was available. Two flat-bottomed steamers were therefore selected, the "Volga" and the "Turkmen" schooner.

The command of the expedition had been entrusted by the contractor to an engineer of the Great Northern Company, whose subordinates were another engineer and four electricians, besides two English jointers. The transhipment, the coiling of the cable from one tank to another, and the superintendence of workmen hired on the spot devolved upon twelve Danish sailors.

On the peninsula of Apchéron, the Administration was to erect the buildings necessary for the station and for carrying out the tests, as well as an overland line of 50 versts, to connect Bakon with the shore-end. The Administration also sent down to the spot several *employés* of the telegraphic circle of Tiflis, in order that they might receive the new line, make themselves acquainted with all the conditions of the laying, and assist in carrying out the tests. Everything was, therefore, ready for the reception of the cable.

(TO BE CONTINUED.)

THE GLOBE TELEGRAPH AND TRUST COMPANY (LIMITED).

Report of the proceedings at the seventh ordinary general meeting of the shareholders of the Globe Telegraph and Trust Company (Limited), held at the City Terminus Hotel, Cannon-street, on Friday, 30th July, 1880; John Pender, Esq., M.P., in the chair.

The Secretary (Mr. Wm. Payton) read the notice convening the meeting.

The minutes of the sixth ordinary meeting were read and confirmed.

The CHAIRMAN: Gentlemen—As you have had the report and accounts in your hands for some time I presume you will take them as read. Before putting the resolution asking you to approve of the report of the directors and the accounts I think it may interest you to give you one or two particulars as to the progress of the Company during the past year. You will observe that we meet under rather better conditions this year than we did last; first, because our securities stand at about 19 per cent. higher in aggregate market value than they did last year; and, secondly, because we are able through increased earnings of the companies to pay a rather better dividend, namely, 4½ per cent. to the ordinary shareholders, as against 4¼ per cent. last year, and this with former dividends yields an average of 4½ per cent. on the ordinary shares since the formation of the Company. I hope this state of things may continue. If the competition between the Atlantic and French companies could be put an end to, no doubt it might. The general progress of telegraphy, which always is more or less elastic when tried, is in a healthy and growing state, and as we have had such a very long term of bad trade, I think we may fairly look for a cycle of good trade by which telegraph property must very materially benefit in the future. As to the settlement of the question of competition, which is rather serious in its effects, going on between the French company and the existing Anglo companies, I am hopeful that the French company being an accepted fact, and we must treat it as such, that good counsels will eventually prevail, and that instead of the very serious loss that is going on now, some arrangement may be come to when the proper time comes for making it. I believe your Board are all in that respect men of peace. At the same time the properties which you are more interested in can only be maintained by showing a firm and decided attitude. But when the counsels of the board of the Globe Company are required to bring about an arrangement, there is no doubt their influence will tend in the direction of peace. As regards the balance sheet before you, it, together with the report, shows the nature of our operations during the past financial year, and they are all of them such as I think would commend themselves to your judgment. The Submarine Cables Trust Certificates have been exchanged for at a price which diminishes our average. They cost us nominally 110 per bond, as we gave in exchange 5 preference and 6 ordinary shares, but the actual price has represented between £85 and £90 per bond, according as our own shares improved in value. The delay in obtaining a decision in the Trustees Appeal case no doubt led proprietors to part with their bonds to the extent of 115. This number we exchanged for our shares. I dare say you are aware that in this case of the Submarine Trust Company the Board appealed against the decision of the Master of the Rolls. His lordship's decision in regard to Trust Companies caused a very great deal of excitement in the City. As a judge he is reckoned, perhaps, the most experienced of all. His decision was against Trust companies. The trustees of the Submarine Trust Company considered it right to appeal against his decision. That appeal has been successful, and Trust companies are now again put upon their proper footing. At all events, that is the case with the Trust company in question. Therefore, we are likely to derive some considerable advantage in respect of the stock which we hold of this Company, on account of its improved value consequent upon the success of the appeal. The 1,600 Eastern Extension and 100 Eastern Telegraph shares were acquired in exchange for our own shares, one ordinary and one preference share for every two shares of these companies, and this without any expense for stamps or fees to our Company. The 374 Indo-European shares have been exchanged for at prices varying from £21 to £23 10s. per share, in exchange for our shares, in equal proportions, at the market prices ruling at the time. The largest exchange has been the German Norwegian Company's shares, which now figure in our list of securities to the extent of about £80,000. As to this, I must say a few words to explain the nature of the security, which we hold to be a good one. The Company was established to connect Schleswig in Germany with Norway. The German Post Office Administration found a difficulty in laying the cable at their own expense, but they have given a subsidy of £7,000 per annum on the capital of £87,500, which, as subsidies go, is a liberal one. Now, this £7,000 subsidy is apportioned as follows:—10 per cent., or £700, for repairs to cables, and 1 per cent. of the capital, or £875, for a sinking fund, and the balance is adequate for a dividend of 6 per cent. In addition to this there accrues to the Company a share in the transit traffic between England and Norway, from which we shall derive some further advantage. Your directors consider it, on the whole, a reasonable exchange, because it shows at least 6 per cent. all round on the shares we gave in exchange. Now, as regards the balance sheet, our payments show an increase of £140 17s. 9d. on account of salaries, and a decrease of about £35 in stationery and general expenses as against last year. The increase of salaries was entirely due to the very large increase in the number of shareholders, which is now about 5,500. To show you the growing confidence which there is in the Globe Company as a security for submarine telegraph investors, I may just state that from the commencement, which was the 18th July, 1873, up to the present time the increase, so far as the number of shares is concerned, indicates progress. On 18th July, 1873, we had 1,777 shareholders; on 18th July, 1874, we had 2,744 shareholders; on 18th July, 1875, we had 3,164 shareholders; on 18th July, 1876, we had 3,651 shareholders; on 18th July, 1877, we had 4,024 shareholders; on 18th July, 1878, we had 4,400 shareholders; on 18th July, 1879, we had 4,480 shareholders; and on 18th July, 1880, we find that there were 5,461 shareholders [hear, hear]. So far the increase has been very marked, in fact, during the last year there has been an increase of over 900 additional shareholders. A glance at the credit side of your accounts shows that this year's transfer fees are £461, which is another evidence of the increase in the number of shareholders, being £140 in excess of last year's fees, and also showing that an increased amount of work has had to be performed. An item of £1,796 9s. 11d., "interest in suspense," which appeared on the asset side of the balance-sheet last year, has now been paid off by a payment in respect of accrued dividend from the liquidator of the old Direct Company, and a small sum in excess placed to the credit of revenue account. Submarine telegraphs are progressing in public favour, as you must all have observed, as a field for investment, because the improvement in the value of the property is very marked indeed. If we take the market price of all the securities held by the Globe on the 21st July, 1880, and contrast it with the same date last year, we find an increase of over £400,000, or a rise in value of about 19 per cent. Now, as regards our own shares, if we take last year's price and this year's, we find a rise in value of about 14⅜ per cent. To show, moreover, the appreciation of the scheme of insurance which the Globe offers by spreading risk over many investments, it may be said that while the market price of our investments is equal to £2,808,226, the market value of Globe shares would be £3,071,812, or £263,586 higher, and equal to about 9⅜ per cent. over the

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market value of the securities the Globe holds [hear, hear]. Now, gentlemen, that is a very striking evidence of the hold which the Globe as an investment has got upon investors in this class of property. To take a hypothetical case, and see what would happen to the Globe Company were the Atlantic competition to be continued and the dividends from the Atlantic companies to cease altogether for a time. Now, I dare say many of our shareholders might like to know how the thing stands with regard to this. We find this encouragement, that whilst the preference shareholders would be absolutely secured, that is, without the Anglo dividends at all, the margin after paying them would be such (provided we get the increased bonuses or dividends which the Eastern Company and the Eastern Extension Company have been shadowing forth to their shareholders) as would give us a dividend which I am not prepared to say the exact amount of, but at all events it would give us a dividend upon our ordinary shares [hear, hear]. The security enjoyed by the preference shareholders is so strong that I am not at all astonished to see the position which the preference shares occupy in the market at the present time; in fact, looking to the difficulty of investing money, I doubt very much if there is a better or sounder security than Globe Preference Shares at the present moment. The directors, in all their operations, have in view the broadening of the security of the ordinary shareholders, and if only the competition now going on betwixt the English and French Atlantic companies could be put an end to the outlook would be better; but, believing, as I do, that there are practical business men connected with these institutions, I do not think that this state of things is likely to continue for a very long period; yet it must continue until on one side good common sense prevails. When that prevails and it may do so soon, we shall, I think, be able to look forward to some years of very decided prosperity for these companies. Now, gentlemen, I thought it might interest you to give you these details of the progress of the Globe Company. I am perfectly satisfied, having looked at it closely from its formation, that it is a company that has become almost a necessity, looking to the extent that submarine telegraphy has grown to, especially to those who have not time to watch individual investments, they find that investment in the Globe gives them an insurance and secures to them an average of dividends higher than they possibly could by any other arrangement secure for themselves by holding shares in any one of the respective companies. Now, gentlemen, with these remarks, I beg to move, "That the report and accounts of the directors for the year ending the 18th July, 1880, submitted to this meeting, be and they are hereby adopted, and that the following dividends be now declared payable this day, viz. :—3s. per share on the Preference Shares, making, with previous quarterly payments, a total dividend of 6 per cent. for the year ending 18th July, 1880, and 3s. per share on the ordinary shares, making, with previous distributions, a total dividend of 4½ per cent. per annum for the year ending the same date." Before putting the resolution I will just say one word, and that is that, as a trust company, we have paid up, I may say, almost to the last shilling what we have received. We have considered that as the companies in which we are interested have reserved funds, that those reserved funds should suffice for equalising their dividend, and that we, as a Trust company, think it right to pay you up to the last shilling almost that we have received. On the other hand, there are gentlemen on this Board who hold the opinion that we should always have a reserve in hand to equalise dividends. But reserves being held by the respective companies, I am of opinion that it would not be quite in accordance with the rules of a Trust company to have what may be called a *double reserve*. But if the shareholders think differently, I shall only be too glad to see the Reserve Fund also accruing in our hands to equalise dividends when it is necessary to do so. However, gentlemen, I will now put the resolution to you.

Sir DANIEL GOOCH: I have the pleasure of seconding it.

The resolution was then put, and carried unanimously.

Mr Pender and Sir James Anderson were re-elected as directors, and this with the re-appointment of auditors was the only business before the meeting. A vote of thanks to the chairman and directors was carried unanimously. There was relatively a fair attendance of shareholders.

SUBMARINE CABLES TRUST.

The ninth ordinary general meeting of the certificate holders in this trust was held at the offices, Old Broad-street, on the 30th ult., Mr. J. Pender, M.P., presiding.

The SECRETARY (Mr. Lewis Wells) read the notice convening the meeting and the minutes of the last meeting, held on the 1st May, 1879, which were unanimously confirmed by the present meeting. The trustees' report, which has appeared in *The Electrician*, was taken as read.

The CHAIRMAN, in moving its adoption, together with the accounts, said it would be in their recollection that at the last meeting there was a good deal of discussion about how it was best to deal with the trust. It was very much the fashion at that time, as they were aware, to speak of the decisions of the Master of the Rolls as those of one of the very highest authorities, and to be of opinion that it was almost hopeless to make any appeal against any of his decisions. However, after looking at the difficulties they would have in converting the trust into a company, it became a question either of appealing or winding up the trust altogether. The very great experience of their solicitor, Mr. Baxter, rather convinced them that they ought not to abandon the matter without an appeal, and therefore, acting on his advice, they appealed, and, as they were aware, the decision of the Master of the Rolls had been reversed; and they were now before them again as a Trust, giving full effect to the original principles upon which the trust was founded. Some people said that the decision ought to be carried further, but those who wanted to contest it must go to the expense of doing so. They had their position established by the decision of three eminent judges, and until some one went to the expense of carrying that further it was their business and not that of the trustees. Turning to the accounts now submitted he said their revenue for last year amounted to £23,132, *plus* the sum of £1,696 dividend accrued on Eastern Extension shares, but not paid until after April 15, making a total of £24,828, against £23,562 in the previous year. The expenditure had been £1,420 against £2,000 in the previous year, but included in the last sum was an amount of £689 reserved to cover legal and other expenses in connection with the action which was brought against the trustees, and which had just been dismissed by the Court of Appeal. The decree of the Master of the Rolls, that they were an association of more than twenty persons carrying on a business for the purposes of gain, and consequently ought to be a limited company, had not been upheld by the Court of Appeal. Three other judges, in addition to the late Lord Westbury and to Mr. Justice Fry, had now declared that trusts of this character were legal, and he did not think, after the elaborate judgments delivered the other day in the Court of Appeal, that any one would be bold enough to take further action against the trust to test a point as to which any doubt the trustees might have entertained had now been removed. Looking at the balance-sheet and revenue account it seemed difficult indeed to say that the trustees were carrying on any business. They were simply the recipients of the dividends earned on the investments of the trust, and distributors of the amount to the certificate holders, with certain other duties specially provided for in the trust deed. After meeting their regular coupons they had an amount in hand of about £4,000 available for the redemption of certificates. With reference to this matter he should mention that during the course of the recent action the trustees were restricted from dealing with the funds of the trust, except under the direction of the Court. They could not, therefore, take advantage of the low prices which prevailed a few months ago to purchase any certificates, for which there was always a very limited market. He took that opportunity of announcing that the secretary was ready to receive offers from any certificate holder desirous of selling his bonds. These offers would be submitted to the trustees in due course, and he need scarcely say that the lower the tender the more chance there was of its being accepted. The trust would now be carried on as heretofore. The interest on their certificates was limited to six per cent., but he thought they might look forward to an improvement in the value of their property. He might also say in conclusion that now they were again in the position they originally occupied, their investments had all materially improved during last year—in fact they had been about the most steady securities going; and having regard to the revival of trade they might look to an improvement in the dividends they received from their investments, and hence the value of their property would be further increased. He then moved the resolution.

The MARQUIS of TWEEDDALE having seconded the motion,

Mr. ASTON said he appeared as a certificate holder, and he congratulated the trustees on the result of the recent appeal. He was at the last meeting, and had great pleasure in agreeing with the solicitor to the trust that the Master of the Rolls was wrong in his decision. He (Mr. Aston) never entertained a doubt that these trusts could be legally carried on, and he did not think the judgment of the Court of Appeal need be tried to be interfered with. He thought they might take it that the trust was established according to law. As to the accounts, he had noticed that they did not put the Eastern Extension dividend in the receipts for the current year. Up to the present time, however, those receipts had always been included in the current year, although not actually payable for a week or ten days afterwards. He thought it would have been better to maintain the uniformity of the accounts, although it was of no consequence except as a matter of comparison. He understood that they had not yet redeemed any of the certificates, but were prepared to do so, and therefore the £4,000 mentioned by the chairman would go for this object. The trust now being established, he should like to ask another question. He did not know whether the trustees had considered it since he last referred to it. It appeared to him that the business of that meeting ought to be to carry out the terms of the deed. There should be six trustees, but there were only five. He had drawn attention to this matter before, and had the trustees considered it? The trust being now reappointed in point of law, it was desirable that they should have the full number of trustees, that they might act if necessary, which they might not perhaps be able to do if they were only five. For instance, he did not believe they could sell any of the stocks forming the trust—they could not do so unless there were four trustees present; and though it was true they might get four out of five, still they would be more likely to get four out of six. Then, if they had to invest again, there must be another meeting at which all the trustees must be present, and, as a lawyer, he thought that "all" meant six. In his opinion the whole scope of the deed was framed on the supposition that there should be six trustees. He raised the very same question at the Share Investment Trust, and was met by the reply that they had taken the opinion of a very eminent barrister on the point. Mr. Justice Fry, however, was afterwards consulted, and advised that the vacancy should be filled up, which was done. If they were going on as a trust he contended that they should have everthing in conformity with the deed. The only point was the question of expense, but that was a matter the certificate holders could deal with as they pleased. He strongly advised that the vacancy in the number of trustees should be filled up—not necessarily at the moment, but afterwards.

The CHAIRMAN, in reply, said he would first answer the remark as to the change in the form of the accounts. The reason for that was this—that they expected that the accounts were to go before the Court, and, as Mr. Aston perfectly understood, the Court only dealt with money received, not money in prospect. As to the question of the additional trustee, it was pretty much the rule at other meetings at which he was present to advocate a reduction rather than an increase in the number of directors or trustees; and really there was a good deal of truth in the argument in support of that policy, because, after all, it generally rested with a few men to deal with any question raised. They had fully considered this matter, and consulted their soliciter on it, and the conclusion at which they had arrived was that it saved the trust £200 a year, and that they perhaps had very much more efficient management than they would have with the addition of another trustee. The addition of another name would give them no additional security; in fact, might make the thing more difficult to work than at the present time; therefore, with the approval of the certificate holders, they had decided, after consulting with their solicitor, to stand by the number of five, which they thought quite ample. Four could do business at any time, and therefore they did not think it necessary to add to the number of the trustees.

Mr. G. SMITH pointed out that Mr. Aston had stated that four trustees must always be present for the transaction of any business, and as they were all getting older, would it not be better that any contingency should be

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provided for? That was of much more importance in his opinion than the extra expense which would be involved in the appointment of another trustee. He made these remarks not in any opposition. He should have thought they would have been glad to fill up the vacancy while the trust was so prosperous. Circumstances might arise when they could not get four present when they were wanted, and in that case the trust would suffer.

The CHAIRMAN said if they saw at any time that the interests of the trust were in the slightest degree in danger, they would take care to protect them. They had listened to these remarks with the greatest possible interest. They knew perfectly well what was intended to be conveyed by them, but they had considered the question in the interest of the certificate holders, and they did not think that an additional trustee would add to the security or improve the management of the trust. They endeavoured to carry out the terms of the deed, and to redeem the certificates as they could to the best advantage. If they found that the trust would be benefited by the appointment of another trustee they would take the necessary steps.

In answer to a question,

The SOLICITOR (Mr. Baxter) said that a general meeting could be called at any time, and it was at a "general" meeting, and not necessarily the annual meeting, that a vacancy in the number of trustees could be filled up.

The CHAIRMAN then put the motion, and it was carried unanimously; and the auditors, Mr. William Newmarch and Mr. John G. Griffiths, were subsequently reappointed.

Mr. ASTON then moved a vote of thanks to the trustees for their perseverance in getting the decision of the Court of Appeal on the decree of the Master of Rolls. Some of the other trusts had already been wound up owing to the decree.

Mr. SMITH seconded the motion, which was carried unanimously.

The CHAIRMAN, in reply, said the trust was now afloat again, and the trustees were very much obliged to them for their kind renewal of confidence. When they had such eminent opinion in their favour as that of the three judges, of Mr. Aston, and of their own excellent solicitor, he thought they might feel comfortable that they would not be disturbed again.

The proceedings then terminated.

SUBMARINE TELEGRAPH COMPANY.

The half-yearly general meeting of the proprietors of the Submarine Telegraph Company between Great Britain and the Continent of Europe was held on the 3rd instant, at the City Terminus Hotel, Sir James Carmichael, Bart., presiding.

The SECRETARY (Mr. S. M. Clare) read the notice convening the meeting, and the seal was affixed to the register of shareholders. The report of the directors stated that the receipts for the six months ending the 30th June, 1880, amounted to £63,866, being an increase of £2,869 over the sum received in the corresponding period of 1879, but this increase was obtained in the course of the first three months of the half year, when the former tariffs were in operation. Since the introduction of the word rate, on the 1st April last, the receipts have slightly decreased, while, on the other hand, the number of telegrams had steadily augmented. The result of the business during the past half year enabled the directors to make the usual addition to the reserve fund, and to recommend the payment of a dividend at the rate of 19 per cent. per annum. The cable between Déolen (near Brest) and Penzance, which was alluded to in the last report, had been successfully laid down; and the agreement between the Paris and New York Telegraph Company and the Submarine Telegraph Companies came into force on the 1st June last, when the line was opened for the transmission of messages.

The CHAIRMAN said he trusted the report and accounts would be considered satisfactory. That was the first time they had been able to pay a dividend of 19 per cent.; but he hoped it would not be the last. He thought he might congratulate them also, because the dividend had been earned at a very moderate increase indeed of the working expenses. It might be of some interest to them to know what the gradual increase of their business had been during the last six months, as compared with the corresponding period of 1879. In the first quarter, ending the 31st March, 1879, they transmitted over their wires 365,580 messages, and in the March quarter of 1880 they transmitted 499,085 messages. Then came into play the new tariff, the word rate, between France and England and the Continent generally. Previously they had this rate, but acting only partially; it was working with Germany and Holland, but it brought them no increase of business—indeed, rather the contrary. Well, in the second quarter of 1879, from March to June, they carried 417,372 messages, while in the same quarter of this year they transmitted no fewer than 557,211 messages. That showed an increase in the last quarter, as compared with the corresponding quarter of 1879, of 139,839 telegrams—that was the increase since the word rate had been in operation; but in the half year the total increase over the same period of 1879 was 273,339 messages. In one day in June last they transmitted 8,367 messages between their office and the Continent. He thought those figures spoke for themselves. At the same time they must be prepared, for a time, with the word rate, as he had always told them, for a diminution, because they must remember that during the existence of the old tariffs they received for country messages 6f., or 5s., and for messages between London and Paris 4f., or 3s. 4d., while since the word rate had been in force, the 1st of April last, they had received 25 centimes, or 2½d. a word for all parts of the country. The differential rates were now done away with, which was a great boon to the public. To meet such a reduction they must look for a very large increase of business, and he thought from the figures he had read to them they might fairly congratulate themselves that that was likely to take place. For the last three months, although there had been an augmentation in the number of the messages, there had been a diminution in the receipts, though the amount was only very small—£600 at the outside; and, looking to the large reduction in the rates, he thought that was most encouraging. He thought they must look forward to the next six months producing a different state of things, particularly if trade should be more prosperous, and if there was a good harvest. In that case there would, he thought, be a much more favourable state of things both at home and abroad; and altogether he thought they might look forward to a cheery future. Their cables were all in good order at this moment, and they had been fortunate enough to have fewer accidents than usual in the past six months; but, of course, in the next six months they might have more. They had, however, taken every means to provide against those accidents. They had a steamer always ready to go to sea and pick up their cables. When they did pick up a cable it was brought in and repaired, and relaid, and they kept all their cables in the best possible condition. He might mention that the steamer was in "apple-pie order." She had been overhauled again under the supervision of the Board of Trade, and he believed that she was one of the finest steamers afloat for the purpose. He concluded by moving the adoption of the report.

Mr. H. C. FORD seconded the motion, and asked whether, in face of the increased traffic, the Company had cable power enough to carry it.

The CHAIRMAN said he thought that up to the present moment they had sufficient cable power, but the time might come, and he hoped it would, when it would not be sufficient.

Mr. CASTLE SMITH asked whether the Board contemplated increasing the reserve fund. When he looked at the reserve fund and the prosperity of the Company he thought that one was very inadequate to the other. There was such a thing as danger even in prosperity. They were very thankful to see that they were building up their dividends, but seeing that they were within one per cent. of 20 per cent. the sum carried forward was very small. As they progressed—and there was every reason to believe that they would do so—the greater would be the temptation on the part of the Government, if not to succeed to the property, to acquire some interest in it. He would, therefore, suggest—and, in fact, make it a motion—that, assuming that the Company should ever pay 20 per cent., all profits over that and beyond the 5 per cent. now provided by the articles of association, should be carried to the reserve fund. Of course they would all be delighted to see the 19 per cent. increased to 20 per cent., but the present rate of dividend was not the climax of their prosperity. He thought a strong reserve fund was very material to the prosperity of the Company, and he urged the shareholders to be contented with 20 per cent., and to put all over that rate of dividend to the reserve fund. He had made these observations without in any way intending to be in opposition to the Board, but merely with the view of promoting the welfare of the Company, to suit their own pockets, and to increase the value of the property.

Mr. FORD seconded the motion.

Mr. RAINES suggested that when they got the 20 per cent. dividend would be the proper time to bring the matter forward. He thought that the remarks of the speaker in favour of the proposition were excellent, but that the time was not opportune.

Sir JULIAN GOLDSMID reminded them that before he was a member of the Board he always supported what was then the practice of the Company—namely, to put by 10 per cent. every year to the reserve fund. A short time afterwards, however, a large number of shareholders from Liverpool and Manchester seemed to have the notion that it was desirable to divide as far as possible everything that could be divided, forgetting that a reserve fund was an essential thing for the prosperity of any company. He opposed what they then proposed, which was to reduce the 10 per cent. added to the reserve fund to 5 per cent. He, however, was in a minority, and the shareholders at that time were strongly in favour of the reduction they made, and it was in consequence of that that the Board agreed to the smaller sum which was carried to the reserve fund; but, fortunately, he thought those gentlemen from the north had not the same influence which they then possessed. It had been pointed out most sensibly that the reserve fund should be increased, and though he thought the motion was not put in the most convenient form he considered that the spirit which suggested it was the right one.

The CHAIRMAN endorsed what Sir Julian Goldsmid had said. It had always been the opinion of the Board that they should have a large reserve fund. They always advocated the transfer of 10 per cent. to the reserve fund, but there was a strong wish formerly to reduce it to 5 per cent., and the Board carried out the wishes of the shareholders. At that time it was the wish of the majority of the shareholders to reduce the transfer to the reserve fund to 5 per cent., and now it was their opinion that they should return to the old 10 per cent. or adopt the motion of Mr. Smith—increasing the dividend to 20 per cent., and adding all profits beyond that to the reserve fund. He thought they ought hardly to look forward to or to anticipate a dividend of 20 per cent., though he thought there was very little doubt that they would receive that rate of dividend. Still, he would suggest that the shareholders should say at once what proportion should be put to the reserve fund. He should be very happy to go back to the 10 per cent. transfer to the reserve fund.

Mr. SMITH thought that unless they carried out the motion that they should only receive 20 per cent. shareholders, "John Bull-like," would afterwards wish to make it another 2 per cent., and say, "make it 22 per cent. first, before carrying out the intention of the resolution." He would submit the motion in the way that was thought best, but as a principle he did not shrink from suggesting that which he thought would be of the most advantage.

Mr. BEATTIE said that he had always shared Sir Julius Goldsmid's opinion, that they ought to add more largely to the reserve fund than they did at present. He thought they ought not to wait until 20 per cent. was paid, his own idea being that it was more practical for them to suggest that the transfer to the reserve fund should be 10 per cent.

The CHAIRMAN said he thought that was the most practical way to meet the question and to give an instruction to the Board that in future 10 per cent. should be put to the reserve fund instead of 5 per cent. He believed that that would meet the wishes of every shareholder present.

The Hon. ASHLEY PONSONBY said he quite endorsed what Mr. Beattie had said—that it was better to move at once that 10 per cent. should be added to the reserve fund; that would meet all requirements. They carried over now almost sufficient to transfer 10 per cent. to the reserve fund.

Mr. BOYCE thought of the possibility of another cable being required. He always remembered what Robert Stephenson said—never divide up to the hilt, and remember the importance of having a large reserve fund.

Mr. RAINES asked what amount would be thought necessary?

The CHAIRMAN thought that that was a question to be discussed hereafter. He, however, thought that the reserve fund could never be too strong.

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Sir JULIAN GOLDSMID remarked that they must always remember that they had a limited concession.

The CHAIRMAN then put the motion for the adoption of the report, and it was carried unanimously. He afterwards moved the declaration of the dividend recommended, payable on an after the 1st of September.

The Hon. A. PONSONBY seconded the motion, and it was carried unanimously.

On the motion of Mr. BEATTIE, seconded by Mr. WILSON, the Hon. A. Ponsonby and Mr. C. Saunderson were re-elected to their seats at the Board.

The Hon. A. PONSONBY, in acknowledging the re-election of himself and colleague, said he hoped they would go on and pay 20 per cent., and accumulate a large reserve fund, which he regarded as an immense power when this concession was at an end. If at that time they had money to lay down other cables they would keep other people out of the field.

On the motion of Mr. KING, seconded by Mr. Beattie, the retiring auditors—Messrs. G. C. Capper and W. R. Cole and Sir T. Dakin—were re-elected.

Mr. SMITH then expressed his readiness to withdraw his motion.

Mr. BOYCE afterwards moved, and Mr. BEATTIE seconded, the following resolution :—"That for the future 10 per cent. of the gross receipts, in lieu of the present proportion of 5 per cent., be added to the reserve fund half-yearly."

The CHAIRMAN put the motion, which was carried unanimously. He afterwards observed that the passing of the resolution was the wisest thing they had done for a long time.

Mr. BEATTIE then moved a vote of thanks to the chairman and directors for their care and attention to the interests of the Company.

Mr. WILSON seconded the motion, and it was carried unanimously.

The CHAIRMAN returned thanks on behalf of his colleagues and himself, and expressed a hope that the next meeting would pass off as pleasantly as the present one had. He congratulated them very sincerely on their having passed the resolution relating to the increase of the reserve fund.

The proceedings then terminated.

INDIA RUBBER, GUTTA PERCHA, AND TELEGRAPH WORKS COMPANY (LIMITED).

The half-yearly general meeting of the shareholders of the above Company was held on the 5th inst., at the City Terminus Hotel, Mr. G. Henderson presiding.

The SECRETARY (Mr. William J. Tyler) read the notice convening the meeting. [The circular announcing the profits, &c., has appeared in *The Electrician*.]

The CHAIRMAN said : We have requested you to meet us to-day in order to obtain your sanction to the payment of an *ad interim* dividend, which we have much pleasure in being able to recommend, and which has been fairly earned. I am glad to say that the business of the Company proceeds in as satisfactory a manner as can be expected, considering the continued high price of india rubber. I beg to move "That an interim dividend of 10s. per share, free of income tax, being at the rate of 10 per cent. per annum, payable on and after the 6th inst., be now declared."

Mr. S. W. SILVER seconded the motion, which was at once carried unanimously.

Mr. D. H. SMALL moved a vote of thanks to the Chairman and the Board of Management for the able way in which they were conducting the affairs of the Company. The profits must have been very good to allow a 10 per cent. dividend being paid, and to carry forward a considerable sum.

Mr. KEYS seconded the motion, and it was carried unanimously.

The CHAIRMAN, in reply, expressed the acknowledgments of his colleagues and himself, and said they would continue to do their utmost to maintain the prosperity of the company.

The proceedings then terminated, having occupied about five minutes.

THE ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).

Report of the directors to the ordinary general half-yearly meeting of the proprietors at the Terminus Hotel, Cannon-street, in the City of London, E.C., on Friday, the 6th day of August, 1880. The total receipts from the 1st January, 1880, including a balance of £5,160 16s. 9d. brought over from the last account, amount to £272,231 16s. 9d. The traffic receipts show a decrease of £19,970 as compared with the corresponding period last year. The total expenses of the half year, including income-tax and repair of cables, &c., as shown by the revenue account, amount to £56,044 9s. 9d. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £75,000 to the renewal fund, leaving an available balance of £141,187 7s. One quarterly interim dividend of 2 per cent. on the preferred stock and of 1 per cent. on the ordinary stock, free of income-tax, was paid on the 1st May, 1880, absorbing £70,000, and a second quarterly interim dividend at the same rates, free of income-tax, paid on the 3rd August, 1880, leaving a balance of £1,187 7s. to be carried forward to the next account. The cable laid by the Company in the year 1873 was broken off the coast of Ireland on the 2nd April, 1880, and was repaired on the 15th of the same month by the Telegraph Construction and Maintenance Company's s.s. "Scotia." The rapidity and efficiency with which the repair was effected reflect great credit upon that company and the officers, scientific staff, and crew of the vessel. With the foregoing exception, the Company's cables, both in deep and shoal water, have continued in good working order and condition during the half year. The determination of the directors, announced in their two last reports, to lay down an additional cable during the present season, between Ireland and Newfoundland, and to renew the inter island cables beyond, is being carried into effect. The Company's repairing ship s.s. "Minia" has been principally engaged since the commencement of the season in taking soundings and in fixing the position at which the new (1880) cable is to be connected to the shore ends of the 1866 cable, which have been found in very good condition, and will be utilised in conformity with paragraph 9 of the report of the directors of the 8th August, 1879. A contract was entered into in the month of April last with the Telegraph Construction and Maintenance Company for the manufacture and laying of 1,506 knots of deep sea cable, and 310 knots of shoal water cable, the former to be laid between Valentia, Ireland, and Heart's Content, Newfoundland, and the latter between Placentia, Newfoundland, and a point near North Sydney, Cape Breton, touching at St. Pierre, Miquelon. The contract price for the above work is under £500,000, and the whole outlay will be paid out of the renewal fund. The above-mentioned lengths of cable, with the addition of 200 miles of deep sea cable in stock, will be connected to the shore ends of the 1866 cable on both sides of the Atlantic, and will form a new line of communication from end to end of the Company's system. The manufacture and shipment of the first section of the shoal water cable has been completed, and the s.s. "Seine" left the Thames on the 11th ult., to lay it. The second section will be laid by the s.s. "Kangaroo." The deep sea cable has also been completed and shipped, and the s.s. "Scotia" is now on her way to Newfoundland to commence the operation of laying the main line of communication from Heart's Content to Valentia. Messrs. Clark, Forde, and Co., telegraph engineers, were appointed by the directors to represent the Company both during the manufacture and laying of the cables, and to advise them upon all technical matters in connection with the preparation and settlement of the contract. The directors of the Compagnie Française du Télégraphe de Paris à New York opened their main cable between Brest St. Pierre and Cape Cod on the 1st February last, but their line of communication between London, Penzance, and Brest, was not opened before the 1st June, and, consequently, the competition for the most important part of the Atlantic traffic did not commence until the latter date. The result up to the 30th June, 1880, is shown in the revenue account, being a decrease in the receipts of the Company, as compared with the corresponding period of last year, amounting to £19,970. It is difficult for the present to predict what will be the outcome of the existing competition at low rates, as a comparatively short time has elapsed since it really commenced, but as the number of the Company's cables will shortly be increased, and as their carrying power has been more than proportionately developed, by scientific appliances which are still being improved, the directors are of opinion that should the traffic increase in the ratio of a large and permanent reduction of tariff now under consideration, the result will be advantageous to the interests of this Company, which not only possesses an important network of cables of its own, but has exclusive and beneficial arrangements with the largest telegraph companies and administrations on both sides of the Atlantic. The directors regret to announce that since the last general meeting they have lost one of their oldest colleagues by the death of Captain A. T. Hamilton, who had been connected with Atlantic telegraphy from its inception, and who for many years was a prominent member of the Board in the capacity both of chairman and deputy-chairman of the Company. Mr. H. Weaver, who for the last ten years has occupied the position of general manager, has been elected to fill Captain Hamilton's vacancy, and has been appointed managing director of the Company.

The report of the meeting will be given in our next issue.

ANSWER TO CORRESPONDENT.

J. D. B.—Your sample of wire did not come to hand. Wires properly insulated with india rubber should certainly not be subject to corrosion such as you mention.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES AUG. 4.		BUSINESS DONE WEEK ENDING AUG. 4. Highest.		Lowest.	
Anglo-American Ordinary	62¾,	63¼	.....	62¾	.....	62¼
Do. "B"	93,	⅛	.....	92⅞	.....	92⅜
Do. "A"	35¾,	36¼	.....	36	.....	35
Brazilian	8⅜,	⅞	.....	8⅞	.....	8 11-16
Cuba ex div. 29 July	9½,	10	.....	9⅝	.....	9⅝
Do. Ten per Cent. Pref. x d. 29 July	16,	17	.....	16¾	.....	16¼
Direct Spanish	1¾,	2¼	.....	—	.....	—
Do. Ten per Cent. Preference	11¼,	⅜	.....	11½	.....	11¼
Direct United States	12½,	⅝	.....	12⅝	.....	12
Eastern ex div. 29 July	9⅜,	½	.....	9½	.....	9 5-16
Do. Six per Cent. Debenture	103,	106	.....	104½	.....	104¼
Do. Five per Ct.do.1890...x d 3Aug.	102,	105	.....	105½	.....	105¼
Do. Six p Ct. Pref ..ex div. 29 July	12⅜,	⅝	.....	12⅝	.....	12⅜
Eastern Extension	9 7-16,	9-16	.....	9½	.....	9 7-16
Do. Six per Ct. Deb...ex div. 3 Aug.	105,	108	.....	106½	.....	106½
German Union	9½,	¾	.....	—	.....	—
Globe Telegraph & Trust	6⅜,	⅝	.....	6⅝	.....	6½
Do. Six p Ct. Preference	12½,	⅝	.....	12½	.....	12⅜
Great Northern	9⅜,	⅝	.....	9¾	.....	9½
Indo-European	23½,	24½	.....	—	.....	—
Mediterranean Extension	2⅜,	3¼	.....	3⅛	.....	3⅛
Do. Eight per Cent. Preference	10½,	11	.....	—	.....	—
Reuter's	9⅛,	10⅛	.....	—	.....	—
Submarine	247,	253	.....	251½	.....	250
West India and Panama	1 9-16,	11-16	.....	1⅝	.....	1⅝
Do. Six per Cent. 1st Preference...	7⅛,	⅜	.....	7⅛	.....	7⅛
Western and Brazilian	6¾,	7	.....	6 13-16	.....	6½
West. Union 7 p. Ct. 1st Mt.	120,	125	.....	—	.....	—
Do. Six per Ct. Sterg.	104,	107	.....	—	.....	—

TRAFFIC RECEIPTS FOR JULY, 1880.

COMPANIES.	July, 1880.	July, 1879.	Increse.	Decrse
Cuba Submarine Company	2,800 estd.	2,932	—	132
Direct Spanish Telegraph Company	1,423	913	510	—
Eastern Telegraph Company	45,279	35,789	9,49	—
Eastern Extension Telegraph Company	32,194	23,411	8,78	—
Great Northern Telegraph Company	23,560	—	—	—

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SLIP

THE HELIGOLAND CABLE.—We regret to hear that the traffic through this cable is *pro tem.* interrupted.

NEWCASTLE.—The authorities at Newcastle have agreed to allow the representatives of the United Telephone Companies to lay underground wires for telephonic purposes.

PARIS TELEGRAPHS.—The *Ministère des Postes et des Télégraphes* is advertising for the supply of a large quantity of pneumatic apparatus for the use of the administration.

BRADFORD.—The works at the new reservoir are being lighted by two of Mr. Crompton's lamps, so that the labour goes on continuously. It is said that the lamps are of 12,000 candle-power each.

CEYLON.—The telegraphic service of this colony has been taken over from the Indian Government, who till this period has administered it. Mr. Skinner is the Postmaster-General for the island, and Mr. Hurley is appointed chief electrician.

DR. TANNER'S FAST.—While Dr. Tanner has been fasting, the Atlantic cables have been feeding. The companies have earned by the transmission of daily bulletins concerning the starving doctor's condition a sum probably not far short of the gate money pocketed on the spot.

CABLING AND POLITICS.—Sir Bartle Frere's recall, which was decided upon, communicated, and made public all within a couple of days, would have occupied six weeks (allowing for the transit of despatches both ways by post) previous to the laying of the South African cable.

LAMPS FOR THE ELECTRIC LIGHT.—M. L. Cémandot suggests the use of spun glass as an effective method of procuring the diffusion of the electric light. He uses a lamp with double glass walls, between which he places the spun glass. Experiments have been successfully made at large warehouses of the Louvre at Paris.

CHROMIUM AND MANGANESE.—It was pointed out by Professor Bunsen that these metals, as well as the metals of the earths, may be deposited from their chlorides by the device of using a large anode, of carbon, and a very small cathode, such as a platinum wire. The solutions must be very concentrated, and, when deficient in conductivity, may advantageously be acidulated with hydrochloric acid.

AN AMERICAN COMPANY.—The Commonwealth Electric Lighting and Manufacturing Company of Philadelphia is a corporation which came into legal existence on the 22nd ult. by the granting of a charter by the State Department at Harrisburg. The objects of the company, as set forth in its application, are to manufacture and supply electricity for illuminating purposes, and also lamps, burners, and other necessary appliances for the same.

SUCCESSFUL CABLE GRAPPLING IN 2,000 FATHOMS.—In our notice of this operation in last week's issue, part of the last sentence in the first paragraph was unfortunately misplaced. The words "late chief officer of the Telegraph Construction and Maintenance Company's steamship 'Scotia'" should be placed immediately after the name Captain Goodsall, to whom they refer. We take this opportunity of stating that the "Chiltern" is still engaged in the work on the cable referred to in our notice.

A NEW COMPANY.—The Electric and Magnetic Company (Limited), with a capital of £500,000, in shares of £10, is formed to carry into effect an agreement to acquire and use any patents granted to Paul Jablochkoff for improvements connected with electricity and other lights, or any other patents relating to machinery, plant, or apparatus for the supply or maintenance of electric and magnetic lights all over the world; to enter into and carry out contracts for lighting any district, city, building, or establishment, &c. The subscribers are: D. Campbell, 7, Quality-court, E.C., 25; W. R. Robinson, 50, Norfolk-square, 25; J. T. Campbell, 17, Warwick-street, 1; S. Canning, 7, Great Winchester-street, 1; A. C. Macrae, 119, Westbourne-terrace, 25; M. R. Pryor, 12, Great Winchester-street, 25; R. Faline, 7, Great Winchester-street, 1.

TELEPHONE FOR THE DEAF.—We have heard of several devices for utilising the telephone for the purpose of enabling deaf persons to hear conversation, music &c. more or less distinctly; and one of the neatest of these is a "dental attachment" for telephones patented by Mr. H. G. Fiske of Springfield, Mass. U.S., and described in the *Scientific American*. It is simply a strip of some material, such as wood or vulcanite, which is a good conductor of sound, attached to the centre of the telephonic diaphragm or to a disc in connection with the latter. This strip is held between the teeth, and transmits the vibrations to the teeth of the upper jaw, so as to affect the auditory nerves; the under surface of the strip being provided with an elastic coating which prevents the vibrations from affecting the lower jaw. The device is applicable either to the electric or to the "string" telephone.

A STAGE EFFECT.—Those who witnessed the performance in Paris of *le Pied de Mouton* will remember that a table is brought on to the stage, and afterwards a candlestick carrying two lighted candles. One of the characters in the play blows out the candles; but as soon as he moves away one of them unaccountably becomes re-lighted. The actor again blows out this light, when the other one becomes kindled; and, becoming enraged, the man takes up the candlestick and blows furiously without being able to extinguish the lights permanently. This effect, which gives rise to some amusement and astonishment, is produced by means of an induction spark which inflames the vapour from a mixture of ether and spirits of turpentine contained within the vessels which represent the wax tapers. An attenuated cable of four conductors connected the latter, and the points between which the spark passed, with the table, and through it with the induction coil below the stage.

THE INSTITUTION OF MECHANICAL ENGINEERS.—The president of the Institution of Mechanical Engineers, Mr. E. A. Cowper, in his inaugural address at the late meeting at Barrow-in-Furness, referred to the various aids received by engineers, and among others he commented on telegraphic communication in the following:—"Telegraphs then came to our aid, to facilitate the interchange of information, and particularly did ocean telegraphs help greatly in the more important communications between continents. I must not here dwell upon the immense variety of telegraph instruments and appliances, whether acting by codes, read by the eye or by the ear, or writing by hand, or recording by a line; but the great acceleration accomplished by duplex and quadruplex signalling, through one wire in both directions, has been a marked improvement of our own age, and contrasts strongly with Professor Wheatstone's original four wires, with the rails of the railway (as was supposed) for a return wire."

TELEGRAPH MISCARRIAGES AT CALCUTTA.—The *Statesman* says:—"It is evident from what has lately been brought to light that the department requires to be remodelled. We are informed that in the check department of the office, where all the messages are kept, a number of apprentices are employed, who virtually draw no salary. We are also told

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that the messages, after a certain procedure, have to be sent to the check department immediately after they are recorded, but we learn that instances have occurred in which messages, after being entered in the record book, have been detained in office without any justifiable reason. Finally, the departmental rules require the assistant superintendent to see that the messages are sent to the check department after being duly recorded, but it appears that this rule had been infringed, and the result is that the check department has not been able to discover the loss of the messages till about a month after. It would appear that both the superintendent in charge of the check department and assistant superintendent in charge of the signal office are in fault, the former for neglecting to see that the messages were sent to the check department, and the latter for not having brought the loss of the messages to notice earlier."

Telegraph Receipts.—The earnings of the Great Northern Telegraph Company for July amounted to £23,560; from January 1 to July 31, to £131,800, against £116,623 in 1879, and £118,366 in 1878.—The Eastern Telegraph Company's traffic receipts for the month of July, 1880, amounted to £45,279, against £35,789 in the corresponding period of 1879.—The traffic receipts of the Eastern Extension, &c., Telegraph Company for the month of July amounted to £32,194 against £23,411 for the corresponding period of 1879.—The traffic receipts of the Direct Spanish Telegraph Company for the month of July were £1,423, against £913 in the corresponding period of last year. The number of messages passing over the lines of the Cuba Submarine Telegraph Company during July was 2,478, estimated to produce £2,800, against 2,504 messages, producing £2,932 in the corresponding period. The receipts for May, estimated at £2,900, realised £2,972. Those of the Eastern Company for July amounted to £45,279, against £36,789; Eastern Extension, Australasia, and China, for the same time, to £32,194, against £23,411 in the corresponding period, or an increase of £8,783; and Spanish, £1,423 against £913.—The *Bullionist.*

Canadian Telegraphy. — A report by Mr. Sandford Fleming, engineer-in-chief of the Canadian Pacific railroad, has been issued from the Canadian Government Printing Office at Ottawa. The principal portion of the report deals with the question of the Pacific Railroad telegraph and a submarine extension of the system to Asia. Mr. Fleming dwells at length on the difficulties in telegraphing over American territory which the Canadian Government will experience now that the railroad in British Columbia is being constructed, and constant communications with that province will be maintained. He advocates the immediate construction of a link between Edmonton and Cache Creek, all that remains unconstructed in the line between Winnipeg and British Columbia. He discusses the best means of establishing telegraphic communications between Fort William and Ottawa, and suggests three schemes by which it can be accomplished. He recommends the laying of a submarine cable from the north part of Vancouver's Island to the Aleutian Islands, and thence to Japan *viâ* the Kurile Islands, connecting with the mainland. Mr. Gisborne, superintendent of the Canadian Government telegraph system, adds that one of the small islands could be purchased from the Japanese Government and used as a landing-place, from which two cables could be laid, one leading to Hong-Kong, in China, and the other to Australia. The cost of completing the Pacific telegraph system and laying these cables is estimated at 4,000,000 dollars.

The Naval Demonstration at Portsmouth.—Ironclads, torpedo-boats, the electric light, and other signs of scientific progress are gradually revolutionising warfare. Of course the great object is to keep defence and attack pretty evenly balanced. If one or the other gains a decided ascendency, good bye to warfare. Would that it might be so. The electric light is becoming more and more important, both in attack and defence. The following is *The Times'* report of the recent demonstration:—"About half-past 9 o'clock there was a night demonstration on a limited scale, the purpose being to ascertain the effect which the smoke from the discharge of artillery exercised upon the beam of the electric light. As is well known, the steam from a torpedo launch illumined by a strong light appears solid and opaque, but the effect upon the light itself of moving wreaths of powder smoke had not been practically tested in action. The engagement accordingly resolved itself into an artillery duel, the 'Glatton,' 'Medway,' and 'Spey' maintaining a tremendous cannonade upon the fort, while the field battery heavy ordnance and infantry of the defences responded with equal vigour. Between them an abundance of smoke was produced, and as there happened to be not a breath of wind blowing at the time the opportunity presented for observation was all that could be desired. There can be little doubt that the result was to diffuse the electric beam and to severely handicap the defence. The lamps used were Siemens's, each having the estimated illuminating power of 14,000 candles; yet notwithstanding this extraordinary energy, the smoke from the guns in their wake seemed to absorb the light to a great extent. Another effect of the diminished brilliancy appeared to be to bring out the figures of the men serving the guns and managing the lights into greater prominence. The object of the demonstration rendered the use of guard boats unnecessary, so that except from the guns the torpedo craft had it all their own way. After the smoke had cleared off a little it was perceived that several small craft had in the meantime succeeded in attaching blue lights to the boom, representing imaginary charges of gun-cotton, to be followed by imaginary but irreparable injury to the obstruction. Subsequently several torpedo craft scrambled through. They were followed by the 'Medway,' apparently through the break made by the morning attack. The 'Spey' afterwards attempted to run the gauntlet, and the demonstration ended with her discomfiture."

Association of Gas Managers.—The following extract from the presidential address of Mr. J. Robb to the North British Association of Gas Managers shows that some gentlemen connected with gas works view the electric light in the right way. He says:—"In looking over our transactions for several years past, I am astonished at the number of so-called inventions and improvements in gas manufacture, and machinery connected therewith, which have been offered for our acceptance, and been urged upon us with much eloquence and many weighty reasons, and yet you all know that few, if any, of them are ever heard of afterwards. Whether this arises from apathy to the interests of our profession, or from that intuitive faculty which it is said we Scotchmen possess in a remarkable degree—I will not say of "seeing through a millstone," but rather of seeing at a glance the real value of anything that is placed before us, I will leave someone else to determine. There is one thing, however, which we cannot set aside, and that is the bold flight of our modern gas engineers in an upward direction. We have seen scrubbers towering above all other buildings in gas-works, and we shall shortly have an opportunity of beholding a gasholder, when filled with gas, rising to the amazing

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height of 160 feet. We may well ask—What next? Some one will say, "The electric light;" but, gentlemen, I think we are far from seeing the realisation of the hopes of those persons who have embarked their fortunes in the production thereof. Yet we need not shut our eyes to the fact that an intense and brilliant light can be produced, which may be used to great advantage in some situations; and although I believe that the time is far distant when it will take the place of coal gas in domestic illumination, yet I am convinced that when the necessity arises for its adoption, science will be able to overcome the difficulties with which the subject is now surrounded. Within the past two or three years it has struck me forcibly that, as gas managers, we have been losing sight of the primary object of our profession, viz., the production of illuminating gas, and have been drifting away in the direction of becoming manufacturers of the secondary or residual products thereof. I am led to this conclusion from the prominence which is given to this subject at all the meetings of our Associations, and from the multiplicity of machinery which has of late years been patented for the purpose of enabling us to enter into the trade. Almost daily we have our attention called to some washer or scrubber newer and more efficient than any other which has preceded it, and if the benefits resulting from the use of these improved appliances are really as great as they are represented to be I do not see how anyone can reasonably delay their adoption. As ammonia is becoming such a valuable article of commerce it may become a question with gas managers how far the amount of this substance contained in a coal should enter into their calculations when making a contract for their yearly supply. The quantity of ammoniacal liquor and its strength have not hitherto formed items in the results obtained from a ton of coal in the analyses sent to us (with the exception of a very few), but I expect it will take a more prominent place in all future analyses. My only fear is that coal merchants will not be slow to take advantage of the additional value conferred on the article in which they deal, and add to the price of the coal according to the quantity of ammonia contained therein. As showing the difference in the quantity of ammoniacal liquor contained in a ton of coal the following is a sample:—Muirkirk 14·00 gallons, Stanrig 3·90 gallons, Foulshiels 24·15 gallons, Shotts 9·06 gallons, Ponfiegh 31·00 gallons. Allow me to apologise, gentlemen, for trespassing so much on your time and patience. It only now remains for me to call your attention to the very interesting list of papers and communications the titles of which you will find in the programme."

The Electric Telegraph.—Such is the title of a paper in Vol. 95 of the *Quarterly Review*, published in 1854, rather more than a quarter of a century ago. Our readers will do well to compare the forecast with the reality as we see it now, when a second cable within twelve months is being laid across the Atlantic, when England, Egypt, India, China, Australia, Cape Colony, &c., are in cable communication:—"The restless spirit of English engineers," says the writer, "having provided for the internal telegraphic communication of Great Britain and her principal dependencies, seems bent upon stretching out her lines to the East and to the West, so as ultimately to clasp the entire globe. The project of connecting, telegrapically, England with America is at the present moment seriously engaging the attention of scientific and commercial men. The more daring engineers are sanguine of the practicability of laying a submarine cable directly across the Atlantic, from Galway to Cape Race, in Newfoundland. Now that we have Lieutenant Maury's authentic determination of the existence of a shelf across the North Atlantic, the soundings on which are nowhere more than 1,500 fathoms, the feasibility of the project is tolerably certain. The principal question is whether, if a line were laid, an electric current can be passed through 3,000 miles of cable. No doubt, by the expenditure of enormous battery power, this might be accomplished through wires suspended in the air, but it is a question whether it can be done along a vast length of gutta percha coated wire passing through salt water. There is such a thing as too great an insulation. Professor Faraday has shown that in such circumstances the wire becomes a Leyden jar, and may be so charged with electricity that a current cannot, without the greatest difficulty, move through it. This is the objection to a direct cable between the two continents; if, however, it can be overcome, doubtless the ocean path would in all possible cases be adopted where communications had to be made between civilised countries having intermediate barbarous or ungenial lands. To escape this, at present, dubious ocean path it is proposed to carry the cable from the northernmost point of the Highlands of Scotland to Iceland, by way of the Orkney, Shetland, and Farroe Islands—to lay it from Iceland across to the neareat point in Greenland, thence down the coast to Cape Farewell, where the cable would again take to the water, span Davis's Straits, and make right away across Labrador and Upper Canada to Quebec. Here it would lock in with the North American meshwork of wires, which hold themselves out like an open hand for the European grasp. This plan seems quite feasible, for in no part of the journey would the cable require to be more than 900 miles long, and as it seems pretty certain that a sandbank extends, with good soundings, all the way to Cape Farewell, there would be little difficulty in mooring the cable to a level and soft bottom. The only obstacle that we see is the strong partiality of the Esquimaux for old iron, and it would be perhaps tempting them too much to hang their coasts with this material, just ready to their hands. The want of settlements along this inhospitable arctic coast to protect the wire is, we confess a great drawback to the scheme, but we fancy posts might be organised at comparatively a small cost, considering the magnitude and importance of the undertaking. The mere expense of making and laying the cable would not be much more than double that of building the new Westminster Bridge across the Thames. Whilst England would thus grasp the West with one hand, her active children have plotted the seizure of the East with the other. It is determined to pass a cable from Genoa to Corsica, and from thence to Sardinia. From the southernmost point of the latter island, Cape Spartivento, to the Gulf of Tunis, another cable can easily be carried. The direction thence (after giving off a coast branch to Algeria) will be along the African shore, by Tripoli to Alexandria, and eventually across Arabia, along the coasts of Persia and Beloochistan until it enters Scinde, and finally joins the wire at Hydrabad, which, in all probability, by that time will have advanced from Burmah across the Indian Peninsula to welcome it. America will shortly carry her line of telegraph to the Pacific shore, and run it up the coast as far as San Francisco. Can there be any reasonable doubt that before the end of the century the one line advancing towards the West, and the other towards the East—through China and Siberia—will gradually approach each other so closely that a short cable stretched across Behring Straits will bring the four quarters of the globe within speaking distance of each other, and enable the electric fire to put a girdle round the world in forty minutes?"

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ELECTRO-TELEDYNAMICS.

BY PAGET HIGGS, LL.D., ASSOC. MEM. I.C.E.

(CONTINUED FROM PAGE 137).

Some other points remain to be considered in the circuits employed for the transmission of power by electricity. One of these relates to the maximum heat effect, such as may be manifested in a calorimeter, obtainable on the exterior circuit, and representing the energy of the motor or driven machine. This maximum heat effect is obtained, as is well understood, when the resistance of the external circuit equals the internal resistance of the *effective* coils of the generator. When the resistances are so related, this maximum heat effect represents one-fourth of the work or energy of the generator. From this maximum the heat-work reclaimed can vary to ± zero, as the external resistance is varied 0 to ∞; and the total work will diminish, passing a value equal to half of the energy, or to the maximum efficiency of the work reclaimed, whilst the relative efficieney increases from 0 to 1.

When the electromotive force of the generating machine is not fixed, and under the condition that the mechanical power to be absorbed is the given quantity, the number of revolutions of the machine will increase as the total resistance (internal and external) is increased. Whilst the external resistance increases, the thermic efficiency will vary in absolute value from 0 to that of the work expended, the relative efficiency varying from 0 to 1.

When the electromotive force of the generator is a given quantity E, the work reclaimed on the second machine or motor during a unit of time is, at the maximum, represented by $c\frac{E^2}{4S}$, when $e=\frac{E}{2}$, and where c is the reduction constant. The expenditure of work will be variable, and $= c\frac{E^2}{2S}$; or the relative efficiency will be $\frac{1}{2}$.

When the power applied to the generator is a fixed quantity, and the electromotive force is variable, thus varying E and e, the work reclaimed by the second machine or motor, $c\frac{V}{S}e$, will approximate more nearly to the work expended at the generator, $c\frac{V}{S}E$, in proportion as $\frac{e}{E}$ approximates to unity.

For the value of $\frac{e}{E}$, or the relative efficiency, constant, the works expended and reclaimed obviously increase in absolute value as does the value of $E-e$. But as the amount of mechanical work varies, so does the absolute value of the thermic work, and the limits of the values of E and e are those set for one consideration of modes of construction by the heat the insulating covering of the machines will support without burning, a kind of limit that has no practical value, since the efficiency of the machine is practically limited by the amount of current that the commutator of the machine will allow to pass without too speedy destruction. The quantity of current in webers $\left(\frac{V}{S}\right)$ determines a total thermic work of $c\frac{V^2}{S}$ calories, of which the two machines take respectively $c\frac{V^2 r}{S^2}$ calories and $c\frac{V^2 R}{S^2}$ calories as motor and generator.

When the two machines are working at a relative efficiency of $\frac{e}{E}$, either should be capable of sustaining a velocity of armature, without heating beyond practical limits, that would produce in a wire circuit of the same resistance as the external circuit to be used in working, a thermic work $\left(\frac{1}{1-\frac{e}{E}}\right)^2$ times greater than the working limit set by the builder of the machine.

The engineer who has to transmit a certain amount of power a given distance will require to know how to select the machines best suited to his requirements; for he will, unless experienced as an electrician, scarcely adopt the alternative of constructing machines for his own use, if not prevented therefrom by patent rights and want of time. The first consideration will be that of the distance to be traversed by the connecting wire, which will require to be of as small diameter as may be consistent with the proper conduction of the current without loss by heating. This diameter and length will give the resistance ρ, which will again determine the best resistances R and r of the two machines (for more than two machines the best conditions have yet to be deduced). With $\frac{e}{E}$ given under the conditions of maximum in the preceding remarks, and with the value of V or $E-e$ deduced at sight from Ohm's law and the number of webers current required, all the data are complete, except those concerning the diameter and insulation of the line-wire. The determinatien of these last mentioned points is worthy to be separately considered.

(TO BE CONTINUED.)

THE TELEGRAPHIC CABLE ACROSS THE CASPIAN SEA.*

(CONCLUDED FROM PAGE 140.)

When the "Great Northern" arrived at Cronstadt, on June 30†, three barges were prepared to receive the cable in their tanks. Thanks to the facilities afforded by the Customs, it was possible to commence the transhipment the next day, and the operation was completed on the 4th (16th) July. The 24 naut. miles of shore-end weighed 180 tons, and this portion of the cable was transferred to one barge. The portions of deep-sea cable were transhipped as follows:—About 28 miles, weighing 112 tons, on to one barge; 34 miles, weighing 133 tons, on to a second; 37 miles, or 148 tons, on to a third; 26 miles, or 181 tons, on to a fourth; and 22 miles, or 86 tons, on to the last barge; altogether 147 naut. miles, weighing 660½ tons.

After the transhipment the tanks were flooded so as to cover the whole of the cable with water, the barges settling down to the extent of 52 inches. The electrical tests still showed a satisfactory result.

On the 6th (18th) July the barges commenced the ascent of the Neva; afterwards they successively traversed the Ladoga canal, the Volkova and Svir rivers, the Onejsk canal, the Marie system of canals, the Korché and Cheksna rivers, and lastly, the Volga. On the canals the barges were raised, by means of 28 locks, 308 feet above the sea-level. The towing was mainly performed by steam tugs, but occasionally by horses and by men; this last method being adopted in the canal of Onejsk and in the Marie system of canals.

The distance traversed by the cable, under constant superintendence and daily testing, was 4,000 versts or 4,268 kilog. up to the date of arrival at Astrakan, viz., the 23rd August (5th September). The voyage lasted 48 days and 14 hours.

The barges awaited until the 30th August (12th September) the arrival of the steamships "Volga" and "Turkmen," which had been ordered to Bakou for the purpose of transporting the cable to the peninsula of Apchéron and laying it to Krasnovodsk The transhipment was effected in the open sea at Beroutchi-Kosa. The first loading of the two vessels was effected simultaneously; about 19½ miles of shore-end and 3 miles of deep-sea cable being transferred to the "Turkmen," and 68 miles of deep-sea cable with 4½ miles of shore-end to the "Volga."

The "Turkmen" proceeded with its freight to the peninsula of Apchéron, whither it arrived on the 8th (20th) September. Thence the laying could be proceeded with from Cape Gourgane; the overhead line having been previously completed. The work was commenced on the 9th. On the next day, the 10th (22nd), part of the cable was laid in a trench, 1½ to 2½ metres in depth, which had been dug over a length of 85 metres, in a broken line, from the telegraph station to the sea. At a distance of 19 metres from the shore, the cable was fixed by means of a chain attaching it to three timbers placed across the trench. When the end of the cable had been brought into the building arranged as a station, the working of the apparatus was commenced. The laying of the deep sea portion in the "Turkmen" was effected from the stern instead of prow of the vessel; the dynamometer and tackle being taken abaft for that purpose.

It would be useless to dwell upon the innumerable difficulties occasioned by the necessity of dividing the cable, of utilising trading vessels for such a delicate operation, and of employing a considerable number of workmen, nearly all of them Tartars, who could be rendered available only through the patience and intelligence of the Danish crew.

Besides the staff of the expedition, a pilot having the grade of lieut.-colonel, and whose knowledge of the Caspian Sea was very useful to the committee appointed to make the preliminary investigations, was employed not only to direct the course of the vessel but to lay down on the chart as accurately as possible the localities where the joints in the cable had passed overboard.

The actual laying was commenced on the 11th (23rd) Septem-

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* Translated from the *Journal Télégraphique*.

† The dates here and previously appear to be given according to the *old style*, or the Julian calendar; the subsequent dates are given both in the old style and in the *new style*, or according to the Gregorian calendar. The difference of 12 days requires to be added to the day of the month according to the old style to obtain the same day in the new style, and *vice versâ*.—[ED. *E.*]

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ber, at 7 a.m., after satisfactory electrical tests had been obtained. The operation, with 19·76 miles of shore-end and 3·75 of deep-sea cable, lasted, until 4·30 p.m., over a distance of 10 miles, the direction being S.W. 48½°, and S.W. 70° by compass. The three joints, one from the shore end, and the others in the deep-sea line, were submerged, the free end of the cable being provisionally attached to an indicating buoy, from a depth of 44 metres, in 40°11′ North latitude and 54′22″ West longitude from the meridian of Bakou. The length of cable paid out was indicated by the counter as 23·5123 miles. The electrical condition had not varied. The soundings taken every half-mile gave: 18, 21, 22, 25, 27 and 28 feet, and afterwards 10, 12, 14, 17, 19, 21, 22, 27, 29 and 34 metres, with a bottom of sand, shells and mud.

On the 12th (24th) September, the "Turkmen," which had returned near to the Apchéron lighthouse, received from the "Volga" 39·77 miles of deep-sea cable. On the next day it started for the Chakovo-Kova, in the south of the peninsula, in order to proceed thence to find the buoy. A north-west wind however prevented the vessel from so doing until sunrise on the 15th (27th). The buoy having been found at 8:30 a.m. the cable was spliced; but the sea was so high that the operation was not completed until 4 p.m. In order that the previous work should not be lost, it was decided, in spite of the state of the sea, to continue the laying by moonlight, and the submersion of the second fraction of the cable was effected during the night. It was terminated on the 16th (28th), a depth of 319 metres being reached. Joints had to be made on five occasions. The length of cable laid was 39·7 miles: electrical condition good. The buoy attached to this second end, in a depth of 138 metres, was 63·22 naut. miles from cape Gourgane, 40°3′45″ North latitude, and 1′46·5″ West longitude from Bakou. The depth during the laying varied gradually from 34 to 319 metres, with a bottom first of shells and afterwards of black and grey mud.

The same day, at 7:30 a.m., the "Turkmen" started again for the Apchéron lighthouse, arriving there at 4 p.m. to receive from the "Volga" a new shipment of cable; but as the latter vessel did not arrive at Bakou before 7:30 p.m. the transhipment could not be commenced before the morning of September 17th. (29th). After being continued all day, the operation was brought to a stop at 1 on the following morning in consequence of a northerly wind of such violence that the "Volga" drifted free, breaking the cables which attached it to the "Turkmen." It was 10 a.m. before the transhipment could be resumed, and this was continued very slowly until 1 a.m. on the 19th September (1st October.) The north wind and rain continued until sunrise. The "Turkmen" had then taken on board 24·8 miles of deep-sea cable and 4¼ miles of shore-end, the former to be joined to the cable at the buoy, and the other for the Krasnovodsk shore.

Provided with this freight, the "Turkmen" was to sail towards Krasnovodsk to lay cable and to await the arrival of the "Volga," which vessel, after quitting the "Turkmen," had returned to the barges at Beroutchi-Kosa. At 10·35 the "Turkmen" weighed anchor; the sea being calm in the vicinity of Apchéron. But, when it entered the open sea, a violent swell, which often follows upon a north wind, forced it to steer for Chakovo-Kosa. It again proceeded seaward at 11 p.m. on the same day; but the swell, which continued during the night and the following day, prevented it from finding the buoy. The "Turkmen" returned, therefore, for the night to Chakovo-Kosa, whither it arrived at 1 a.m. on the 21st September (October 3rd).

At 5:45 a.m. it again proceeded to sea, and succeeded in finding the buoy about three p.m. The end of the cable was immediately taken on board; and after the electrical tests had been made, and the splicing effected, at 10 p.m., the laying of the third length was commenced under a slight wind but in a heavy swell. The submersion of 18·59 miles of deep-sea cable was successfully completed on the the morning of the 22nd (4th). The buoy was anchored in a depth of 74 meters, at a distance of 81·78 miles from Cape Gourgane, latitude 40°16 N, and longitude 2°9′3″ West of Bakou. The bottom had varied from shells to mud, with a depth of from 319 to 76 metres.

The "Turkmen" then sailed towards Krasnovodsk, in the direction of the promontory designated for the laying of the cable. On its arrival at 4 p.m. the lengths of cable necessary for the gulf, and the promontory were in the first place cut off. About mid-day on the 23rd September (5th October) the shore-end was laid along the Krasnovodsk quay; the extremity having been brought into the telegraph station. The cable was buried in a trench, 2 metres in depth, along the quay, which is 15 metres in breadth. On the next day the "Turkmen" took the direction of the gulf of Krasnovodsk to proceed with the laying of the cable, comprising 3·37 miles of shore end, and the cable to reach as far as the sand-bank. It then anchored, and the laying of the cable across the promontory was commenced, and continued, with a delay occasioned by the violence of the wind, until 9.m. on the 25th (7th). Whilst the trench was being made at the promontory, the steam-vessel rounded the latter in order to lay in the sea the end of cable which was to be connected to that across the promontory, arriving at 6 p.m., after having laid 68 metres of cable on the promontory.*

On the following day, 26th September (8th October), the carriage of the remainder of the cable, half a mile in length, for the promontory was commenced by the steamship. This operation being completed at 8 a.m., a buoy was placed opposite the headland at a distance of 129·3 miles from Cape Gourgane.

The "Turkmen" then returned to Krasnovodsk to await the arrival of the "Volga;" and, as there remained on board one mile of deep-sea cable and ·86 mile of shore-end, it landed there near Krasnovodsk in order that an enlargement of the tanks might be effected.

The "Volga," having finished its operations at Berontchi-Kosa, arrived at Krasnovodok on the morning of the 28th September (10th October), bearing 28·6 miles of deep-water cable.

The transhipment on board the "Turkmen" was effected early on the following day. This vessel afterwards proceeded, at 2 p.m., towards the open sea, in order to lay the remainder of the cable; but the heavy sea and wind forced the schooner to return to the gulf of Krasnovodsk on the 30th (12th). At 10 p.m. it anchored near the lighthouse, awaiting the falling of the wind, which occurred at 3:30 in the morning of the 1st (13th) October. At 2 p.m. it found the buoy left after the third operation of laying.

The laying of the last portion of the cable, somewhat retarded by the necessity for cutting out a kink, was commenced at 6 p.m. on the 1st (13th). This operation was commenced from the buoy left near the promontory of Krasnovodsk. The two steamships met at this point. When the submerged end was raised to be jointed on board the "Turkmen," the long-expected ringing of the electric bell occurred at Cape Gourgane. The operation was ended! At 5 p.m., after the submersion of the last joint, the first despatch was received on the instruments at Cape Gourgane. In this last portion of the laying, four joints were submerged: the sea-bottom was of mud and shells.

The final experiments were made at the Cape Gourgane station, by the electricians for the contractor and a committee from the staff of the department of telegraphs, on the 7th (19th October), in presence of a delegate from the military circumscription.

The following are the results obtained:

	Apparatus of the Depart. of Telegraphs.	Apparatus belonging to Contractor.
Copper resistance per mile at 70° Fah.	11·484	11·524 ohms.
Insulation resistance per mile, without correction for temperature	1382	1216·8 megohms.

These figures being in accordance with the stipulations of the contract, the cable was accepted by the Government. In consequence of this acceptance, the exchange of messages commenced between Bakou and Krasnovodsk by means of Morse apparatus with the Taylor relay.

The total length of cable supplied is accounted for as follows:—

		Naut. miles.	Naut. miles.
Shore-end	from Cape Gourgane...	19·7633	
	,, Krasnovodsk.....	3·3710	
Deep-water cable		114·7544	
			137·8887
Joints and ends cut off by buoys ...			·2100
Reserve deep-water cable at Krasnovodsk			·0800
Reserve shore end at Bakou		·8657	
Reserve deep-water cable at Bakou		7·9956	
			8·8613
			147·0400

The proportion of the cable on the chart gives as the length 132 naut. miles; and the quantity of cable taken up by the curves is 4½ per cent.

In order to watch over the preservation of the cable, periodical tests have been carried out at the Cape Gourgane station. During six months the results have been satisfactory; after submersion the insulation improved.

Thus was brought to a happy issue the laying of the Caspian Sea Cable, an operation which occupied 24 days, of which six were for transhipments, nine for voyages and delays, and nine for the laying itself. Of these last mentioned days, five were taken up in laying the shore-ends at the two stations, and on the promontory of Krasnovodsk, and only four for the laying of the deep-water cable.

* [This is somewhat obscure; but it would appear that the cable was taken across a headland through a trench, instead of being carried round it.—Ed. *E.*]

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INSURANCE.

Those employed in the work of the large cable companies will, we are sure, be glad to see the realisation of the insurance scheme which has so long been under consideration. However willing directors may be, it is not always possible to carry through in a short time any suggestion which is not primarily connected with their actual every-day work. Their first consideration must necessarily be to see that their lines are in good order, their staff efficient, and to give their shareholders a fair dividend. The maintenance of a cable line is frequently a costly business, and as the dividends depend upon its capability to carry the messages sent for transmission, this work is of a primary character. The efficiency of the staff depends on a number of things, among others, physique, business tact, knowledge of the world, and so on, as well as the mere ability to manipulate the instruments put into their charge. Having obtained the right kind of men, the question of pay must be settled. Some of the *employés* who have favoured us with communications, seem to think that they alone are able to state the remuneration adequate for their services. It should never be forgotten that "pay" is to a certain extent governed by supply and demand. We have reason to believe that every cable company could supply its demands ten times over, and that new comers anxious to make a good impression, and to gain work, offer to undersell those already in the service. Of course the value of a servant depends a good deal on his experience, but experience may, both from the masters' and from the servants' point of view, be purchased at too high a price. Whilst, however, there is a limit to the price to be paid for experience, the fact remains that experience has its money value. This, indeed, is tacitly admitted by almost every master in every business, inasmuch as the *employé* expects, and generally receives, an increase of salary after having held his situation some time. As a rule, it pays the master to be generous instead of the reverse. Besides mere money payments, there are other means direct and indirect of cementing the attachment between employers and employed.

For many months, we might almost say years, a number of directors in various cable companies have interested themselves not only in the present but in the future welfare of those employed at the cable stations. The life in many cases is known to be vastly different from that at home, comforts are lacking, inconveniences have to be borne, friends are far away, the work, if not physically laborious, has sometimes so little change as to become rather monotonous. Great care has been taken in such companies as the Eastern to provide for the non-working hours as well as for work. Music, books, athletic sports, and such like recreative amusements are supported or provided.

The movement so long suggested to assist the employed in assuring their lives, either for annuities receivable at a certain age, or for provision for their families at death, has now received the assent of all the great companies. It has been proposed to the shareholders at the various meetings, discussed, and agreed to, as an honourable effort of the directors to assist the staff. We need not dwell upon the fact. It is a step we have long advocated, and we are sure that the efforts of the directors will be appreciated by the staffs, and that the companies will not in the long run be losers by such an act. Unfortunately, it is impossible to gain experience in any way but one, or as the old maxim says, "It is impossible to put old heads on young shoulders." Insurance is not well understood by young men, and generally they do not take time by the forelock of their own accord, but require a vast amount of persuasion, and it is even then doubtful if they fully recognise the excellencies of the arrangement till many years have elapsed. Mathematicians may discuss the minutiæ of average and probabilities, but every man, be he young or not, will understand that taken year for year a portion of the population of the world will die. They also know that death comes to young and old, and that of the population dying the ages are varied from the youngest to the oldest. Insurance companies calculate how long any insurer probably has to live, they know the expenses of the office, and hence can obtain the information how much a man should pay half-yearly or yearly in order to obtain a certain sum at a certain time. It may be that now and again an epidemic comes and upsets the calculations of the actuary, but his knowledge of "average" and "probability" enables him to foretell the necessary payments when spread through a series of years. The longer the probability of life, the less the periodical sum to be paid; hence, the younger the person who insures, all other things being equal, the less he has to pay. A little consideration of the question would show this to the young man entering upon life, and it is to be hoped that the aid held out by the cable companies to their *employés* will tend to induce the young men to insure as soon as they enter the service.

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ELECTRICAL METALLURGY.

The electrical furnace or crucible described by Dr. Siemens on the 3rd ult. before the Society of Telegraph Engineers is an invention of such scientific importance, and so greatly augments in certain directions our power of acting upon refractory materials, that any misconception as to its proper sphere of application would be peculiarly unfortunate. The results to be obtained by means of this device for obtaining temperatures exceeding that at which the dissociation of the ordinary combustion-products occurs, and at which carbon and hydrogen consequently refuse to combine with atmospheric oxygen, may very probably prove to be of such utility and beauty that the rising generation will—supposing the implied suggestion that it should be used for the fusion of steel to be alone carried into effect—consider that the invention in question was at first scarcely appreciated as well as singularly misapplied.

The electrical furnace, in fact, appears to us to be clearly inapplicable, excepting under certain very special circumstances, for purposes such as the above, which, as it appears to us, it can accomplish only at a disadvantage in regard both to economy and efficiency. Moreover, certain data appear to have been very much strained in order to show an economical advantage which in reality does not exist.

That such is the case is indicated in an article by M. E. Hospitalier, printed in *La Lumière Electrique*, for the 14th ult. Before referring to the observations of this writer, it will be useful to follow his example by reproducing the description given by Dr. Siemens of the apparatus by means of which he effects the electro-fusion of such material as iron or platinum.

The apparatus in question consists of an ordinary crucible of plumbago or other highly refractory material, placed in a metallic jacket or outer casing; the intervening space being filled up with pounded charcoal or other bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum or dense carbon, such as is used in electric illumination. The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively large dimensions. At one end of a beam, supported at its centre, is suspended the negative electrode, by means of a strip of copper or other good conductor of electricity; the other end of the beam being attached to a hollow cylinder of soft iron, free to move vertically within a solenoid coil of wire presenting a total resistance of about 50 ohms. By means of a sliding weight, the preponderance of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. One end of the solenoid coil is connected with the positive, and the other with the negative pole of the electric arc; and, being a coil of high resistance, its attractive force on the iron cylinder is proportional to the electromotive force between the two electrodes, or, in other words, to the electrical resistance of the arc itself.

"The apparatus of M. Siemens," says M. Hospitalier, "is therefore a true electrical regulator, working by means of a derivation. In the experiment we witnessed, the electrical current was supplied by two medium-size Siemens dynamo-electric machines, coupled 'for quantity.' Measured by the electro-dynamometer, the current traversing the apparatus varied between 70 and 80 webers per sec. After a first operation, lasting 12 minutes, by which the crucible became heated, an ingot of steel weighing 500 grams was fused in exactly four minutes and a half.

"Never before has so important a result been obtained in this direction. The fusion of considerable masses of metal by the heat of the voltaic arc is now an accomplished fact. What has now to be done is to examine the advantages of this metallurgical process, its economical value, and the applications it may obtain in the future.

"One of the greatest advantages of this mode of fusion is that the temperature obtainable is theoretically illimitable. In other apparatus for fusion, the limit of temperature is that at which the dissociation of carbonic acid and water vapour takes place, viz.: a temperature varying between 2,000° and 2,500° Centigrade. Moreover, by means of the voltaic arc fusion may be effected in a perfectly neutral atmosphere, since the crucible may be closed, and the substance to be fused withdrawn from the action either of oxidising or reducing bodies. Further, the heat is developed within the substance itself which is to be fused, whereas ordinarily the exterior of the crucible must be heated before the heat can penetrate to the mass to be melted.

"From the point of view of calories consumed and utilised, there is," says M. Hospitalier, "a better utilisation and a higher duty in the case of the electrical crucible. But let us at once point out that this better duty is merely apparent.

"In the ordinary metallurgical processes, about one kilogram of coal is required to melt a kilogram of mild steel, when the regenerative principle is applied. Now, a kilogram (about 2·2lb.) of coal, in the best steam engines known, can produce one horse-power (270,000 kilogrammètres) during one hour. The corresponding work, transformed into electrical work by a dynamo-electrical machine of good construction, and again transformed into heat by electric arc within the fusing crucible, will there produce one-third of the heat which the work represents, viz:—

$$\frac{270{,}000}{3 \times 424} = 212 \text{ calories.}*$$

So that after the successive transformations of the energy stored up in a kilogram of coal we are able to utilise only 212 out of the 7,000 calories furnished by the direct combustion of the coal. Or in other words $\frac{32}{33}$ of the calorific energy have been lost, and $\frac{1}{33}$ is utilised within the crucible.

"In order to melt a kilogram of steel, we require to obtain a temperature of 1,800° C., which is an easy matter with the electrical crucible, and to supply 450 calories to the metal. The fusion of a kilogram of steel within this apparatus (already heated) will therefore necessitate the combustion of $\frac{450}{212} = 2{\cdot}12$ kilograms of coal. And the fusion by means of electricity would therefore cost, *in coal*, 2·12 times as much as the fusion by direct combustion.

"The figures given by M. Siemens," says M. Hospitalier, "are somewhat different from ours, and for the following reasons:—

"M. Siemens assumes that a good steam engine, working expansively and with condensation, converts 20 per cent. of the total energy of the coal into mechanical energy. For this figure to be accurate, the machine must consume only 450 grams of coal per effective horse-power per hour. We do not think that such a result has ever been obtained; and the figure of *one kilogram*, which we have adopted, appears to us to be rather under than over the mark."

In this we quite agree with M. Hospitalier. One datum which we adopt is that the intrinsic energy of one pound avoirdupois of good coal is 11.000,000 foot-lb., or about 7,970 British Centigrade calories (1lb. of water raised through 1° Centigrade). Another datum may be taken from the Presidential address of Dr. Siemens to the Society of Telegraph Engineers, in Jan., 1878, in which that distinguished physicist stated that "the power of 100 horses can be produced with an expenditure of 250lb. of coal per hour if the engine is constructed upon economic principles." One horse-power exerted for one hour being equivalent to 1,980,000 foot-lb. of work, it follows that only 7·2 per cent. of the intrinsic energy of coal is actually converted into mechanical work by an engine constructed upon economic principles. Assuming, with Dr. Siemens, that one-third of this mechanical work is converted into heat within the electric crucible by a good magneto-electric machine, the useful effect in this apparatus would be equivalent to $\frac{7{\cdot}2}{300} = \frac{1}{42}$ of the heat energy residing in the coal. The quantity of heat requisite to fuse 1lb. of steel, in a crucible already heated to the point of fusion of the metal, being 450 British calories (represented by 1lb. of water raised through 1° Cent.) it follows that the quantity of coal requisite for the purpose is that weight which will produce $450 \times 42 = 18900$ of the same units of heat. And thus the weight of coal necessary to effect the fusion of 1lb. of mild steel in the electrical furnace will be $\frac{18900}{7970} = 2{\cdot}4$lb. roughly. The figures arrived at by M. Hospitalier appear therefore, as he says, to be understated rather than the contrary, and those arrived at by Dr. Siemens to be altogether too favourable to the electrical furnace.

ALTERNATING CURRENTS AND THE ELECTRIC ARC.

The alternating currents produced by dynamo-electric machines of the Alliance type, and also by the more recent types of Gramme and Siemens, have been little studied, owing, perhaps, to the difficulty of applying ordinary methods and instruments to currents of great intensity changing their direction one or two hundred times a second.

The difficulty has, however, been got over by M. J. Joubert in employing a Thomson electrometer in a novel manner. M. Joubert

[* The original *calorie*, or unit of heat, of Dulong, viz.: the heat that will raise 1 gram of water through one Centigrade degree of temperature, corresponds to 423·55 gram-metres. The engineer's calorie (French) is 1,000 times greater, and corresponds to 423·55 kilogrammetres, or to 1 kilogram of water raised 1°C. in temperature.—Ed. *E.*]

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dispenses with any foreign source for charging the needle or quadrants. The two pairs of quadrants are insulated; one of them being put in permanent electric communication with the needle, which is also insulated. In these conditions the deviation of the needle is proportional to the square of the difference of the potentials of the two (pairs of) quadrants, and, consequently, is independent of the sign of that difference. If the two quadrants are put in communication with the two points A and B of a circuit traversed by a current of continuous intensity I; if V_1 and V_2 be the potentials of the two points A and B, and R the resistance of the conductor separating them, we have

(1) $$I R = V_1 - V_2.$$

If between two other points A^1 and B^1, instead of a single conductor, we replace an electro-motor or other engine capable of transforming electro into any other form of energy, the equation becomes

(2) $$E + 1 R^1 = V^1_1 - V^1_2,$$

R^1 being the proper resistance of the motor at rest, and E its electromotive force during the movement. The electric energy consumed between the two points A^1 and B^1 has evidently for its expression,

(3) $$I (E + I R^1) = \frac{(V_1 - V_2)(V^1_1 - V^1_2)}{R}$$

The values of the second members of the equations 1 and 2 are furnished immediately and without calculation by the electrometer, if it has been graduated in volts by means of a Daniell battery. One electrometer gives, then, a measure of the intensity, and two electrometers combined the energy consumed.

If, instead of a continuous current, we have to deal with alternating currents succeeding each other at intervals relatively small to the period of oscillation of the needle, the latter, drawn always in the same direction, whatever be the sign of the needle, takes a fixed deflection proportional to the mean of the successive values of the square of $V_1 - V_2$. This mean will also be given, not without grave difficulties, however, by the calorimetric or electro-dynamic methods. In this way M. Joubert finds that to burn a Jablochkoff candle, under the normal conditions corresponding to an intensity of 50 Carcel burners, a current of mean intensity equivalent to 8 webers or 9 webers is necessary. The candle goes out when the intensity falls below 5 webers. The difference of potential between the two carbons is about 40 volts. The work corresponding to the energy of an ordinary candle is about $\frac{8 \times 40}{9{\cdot}8}$, or 32 kilograms per second.

This method of M. Joubert's is of itself very valuable, but he has not contented himself with merely enunciating it. He has applied it to the elicitation of the law of the intensity of the currents as determined by means of a Siemens alternating current machine.

The principle of his application consisted in dividing the period into a certain number of equal parts, say twenty, corresponding to intervals of $\frac{1}{2000}$ of a second, and in measuring the intensity at each of these instants. For this purpose he employed an interrupter mounted upon the axle of the machine, and forming by a movement lasting about $\frac{1}{20000}$ of a second a derived current drawn from the principal current. The intensity of this current could be measured by the electrometer, or by a galvanometer, when the successive contacts corresponded to the same kind of current. In the latter case M. Joubert employed a compensating method of great exactness. It should also be mentioned that a species of phenakisticope mounted on the same tree allows the arc to be seen at the same time, and an optical examination to be made of the phenomena of which it is the seat during the time.

Experiment has given M. Joubert a curve for the intensity which is almost identical with the smusoid, except a slight dissymetry displacing the maximum in the direction of movement. The smusoid is itself bodily displaced in this direction from the theoretical position in the direction of movement by a quantity equal to $\frac{1}{8}$ of the entire period. A similar fact occurs in all magneto-electric machines, and it is usually attributed to magnetic retardation. In the case in question this explanation cannot well hold; the bobbin is without a core of soft iron, and the observed displacement is independent of the speed of rotation. The displacement is evidently due to the induction of the current on itself, the primary current being of the form A sin x, the secondary one of the form B cos x, and the superposition of the two gives a current of the form C sin $(x + y)$, differing from the first only in amplitude and phase.

M. Joubert has in the same way analysed the fall of potential between the two carbons of the arc at different phases of the period. In fact, the method furnishes a satisfactory reply to several interesting questions, such as, What is the resistance of the arc? Is the current continuous across the arc, or does it pass in jets? Is the arc a simple resistance, or does it yield an electromotive force? M. Joubert finds that when the intensity of the current flowing in the arc is *nil*, that is, when the current is changing, the potential between the two carbons is *nil;* but in an inappreciable time the difference of potential rises to 40 or 45 volts, and keeps so till the current again becomes very feeble. The final fall is very sudden. Moreover, this difference remains not only the same during the period of a current of mean given intensity, but even when the mean intensity of the current is varied within wide limits. The difference diminishes, however, when the intensity increases, and the variation amounts to from 4 to 5 volts.

The resistance of the arc is very feeble; it varies with the temperature, and diminishes when the temperature increases. The difference of potential which exists between the two carbons is due for the most part to electromotive force independent of the intensity, and valued at about 30 volts. Particles pass between the two carbons as between the two poles of a voltameter. They establish, by a phenomenon of polarisation, a fixed fall of potential, and from that time the work done is proportional to the quantity of electricity passing. Moreover, if the arc is produced in a magnetic field subject to the same periodic variation as the current, the fall of potential between the two carbons takes a value greater than under ordinary conditions, and increases with the intensity of the field. This curious fact is worthy of deep thought and further investigation.

CABLE FOR TELEPHONIC CIRCUIT.

An English patent has been taken out for a type of conductor designed by Messrs. E. Holmes and E. T. Greenfield, of Brooklyn, New York, to eliminate the effects of induction electric conductors running close together. The arrangement is novel, and worthy of some notice. It is well known scientifically that the intensity of the induced current depends largely upon the parallelism between the conductor in which such a current is generated and the primary line, and that such a current grows feebler as the parallelism of the lines is destroyed, and becomes inappreciable when the lines cross each other at right angles. It has been proposed to utilise for a telephonic line a metallic circuit, the return wire of which shall be made to cross and recross repeatedly the main wire of the circuit, the expectation being that such a line will not be disturbed by induction from a neighbouring wire through which an electric current is passing. One practical objection to this construction is that it requires double the length of wire as compared with a construction which uses an earth connection, and also is attended with a vastly increased resistance; moreover, it proposes the protection of a single line only. The new invention provides a more simple and less expensive mode of utilising the general fact above noted, and is perfectly adapted to any number of lines arranged in proximity to each other, and following the same general direction; and it consists simply in weaving the lines in and out among themselves, so that they will repeatedly cross and recross at short intervals, each line having an earth connection, and consequently no metallic return wire. The most convenient manner of securing this relative arrangement of the wires is to braid them together into a cable, for which purpose they must be properly insulated to prevent contact of the conducting surfaces. By braiding the wires each one of the system will cross and recross each and every one of the others, and if the work is carefully done, as with machinery, the construction will be uniform throughout, the nodes occurring at regular intervals, and the curves rising to uniform heights from the axial line of the cable, which regularity of construction will produce the most complete results. By braiding, each wire is made to act as a support to its neighbours, and while the wires thus serve to support each other the whole cable can be as readily mounted on poles, or otherwise supported or submerged, after the manner of a single wire. A cable constructed according to this plan may be composed of three insulated wires braided together; but manifestly, the same system would apply to any larger number of wires which equally well might be braided up into a single cable. If two wires only were to be used they might be braided into a cable by using as a third strand a cord of any non-conducting material, or they might be secured by sewing, or in any other available way, to a strip of tape or any other suitable support. In this case two wires are attached to a narrow strip in such a way as to cross and recross each other at short intervals and with regular curves. According to the inventor, when conductors are arranged as above described, no induced current is formed in any one of them by the passage of an electric current through any of the others, or if formed it is so far modified from what it would otherwise be as practically not to interfere with the working of any of the lines in the cable, and the same, measurably, would be true of them with reference to any other line near by but not included in the same cable.

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SOME RECENT ELECTRICAL "NOVELTIES."

It is always curious and sometimes surprising to find how early the idea of a recent invention has been mooted or its principle propounded by some other mind which lived before the time was ripe for the realisation of its schemes. "Nothing new under the sun" is a proverb to which these inventive times is ever giving proof. Edison's "Ore Separator" is a contrivance which has been again and again shown to be no novelty, but few are aware how old it really is—at least, in idea. It actually belongs to the last century; and, for aught that we know, may have entered into the idle dreams of Tubal Cain. In an English patent of date June 19, 1792, No. 1,891, William Fullarton, of Ayr, in Scotland, describes a new process for "separating iron from iron stones and other ores of that metal, of smelting it into the state of pig or cast iron, and of reducing or refining it into the state of malleable or forged iron." The patent was granted in the old style by King George III. for "His Kingdom of Great Britain, called England, His Dominion of Wales, and Town of Berwick-upon-Tweed, and also His Plantations abroad." That is a long time ago, but not before "telegraphs were thought about," for Charles Marshall, writing from the same district in Scotland, had long before (in 1753) suggested the principle of the electric telegraph; and Lesage, in 1774 had actually operated a frictional telegraph of the kind planned by Marshall.

Fullarton's patent goes on to describe the method of ore separation adopted by him. This consisted in crushing the iron ore by grinders, stamps, or mills worked by hand, horse, steam, water, wind, or other power, and, in the next place, of separating all "earthly, (*sic*) impure, and extraneous matters from the metallic particles by all or any of the following operations, namely, by washing, levigating, buturating, wennowing, and by the application of magnetic attraction, according to the nature and qualities of the different stones and ores." The materials thus purified are put into the furnace and smelted.

The electrical railway of Dr. Werner Siemens finds a forerunner in the "dynamic traveller" of Henry Pinkus, patented on March 1, 1834, No. 6,570, for the propulsion of vessels, carriages, &c., on canals, railways, or common roads. This invention relates to a pneumatic railway in which magnetic attraction may be employed, and which may either form "a complete system of railway in itself," or be applied to common railways or canals.

An extended tunnel, tube, pipe, or conduit is laid down, which contains a piston. On one side of the piston the air is exhausted from the tube by suitable stationary engines and pumps at suitable distances along the line. To the piston is attached "a vehicle or machine," called "the dynamic traveller," which is in connection with a car on the outside of the tube, called "the governor," to which the carriages to be propelled are attached. In the pneumatic railway itself the rails are cast on the sides of the tubes; but in its application to existing railways or canals the tube is laid down between the rails, or at the margin of the canal. The connection between the dynamic traveller and the governor is made either by means of a longitudinal "pneumatic valve," through which a vertical wire rises, or by magnetic attraction. To apply magnetic attraction effectively, the dynamic traveller carries a frame of horseshoe magnets, set transversely, with their poles placed as near to the under surface of the tube as possible. A similar combination of similar magnets inverted is attached or suspended under the body of the governor, and in order to enable the space between the poles of the magnets in the two frames to be as small as possible, the upper part of the tube has a copper plate fitted air-tight into the opening instead of a valve. In the dynamic traveller soft iron may be used instead of magnets, and electro-magnets may be used.

As regards the production of motive power by electricity, we have the patent of Miles Berry, a communication from Edwin Williams on behalf of Thomas Davenport, dated June 6, 1837, No. 7,386. This invention describes a means of obtaining rotary power by "galvanic" magnets alone, or "galvanic" magnets in combination with "permanent" magnets. The device in question consists of a number of electro-magnets fixed radially on a rotating shaft, and segmental permanent magnets, or electro-magnets, fixed to the frame supporting the rotating shaft. The motion of the rotating magnets is made to take place by the attraction of their poles towards the poles of the fixed magnets of opposite name. To effect this the rotating electro-magnets are made to change their polarity at proper times by the motion of plates (connected to the circuit of the electro-magnets) against segmental plates, corresponding in number and position to the number and position of fixed segmental magnets, which segmental plates are connected in a suitable manner with the poles of a galvanic battery.

AN ELECTRO-DYNAMIC PARADOX.

Dynamo-electric machines, like M. Gramme's, are reversible and can either generate a current from mechanical work, or, from a current, produce mechanical work. Under the same conditions *continuous* current magneto-electric machines do the same thing. But if the current from a dynamo-electric machine is sent into a magneto-electric machine, a very strange effect results. This effect is signalled by M. Gérard-Lescuyer, who calls it an electro-dynamic paradox.

Soon as the circuit is closed the magneto-electric machine begins to move, and tends to acquire a speed proportional to the intensity of the current actuating it. But suddenly it slackens speed, stops, and then begins to rotate in the contrary direction, only to arrest itself anew and begin again as before. In a word, it exhibits a regular alternative motion, lasting as long as the current which actuates it.

What, asks M. Lescuyer, is the cause of this phenomenon? Evidently the motive current changes its direction; and a galvanometer introduced into the circuit proves it. But how does it produce itself when the speed of the prime mover, be it steam or other engine, does not vary? The effect must be due to an exterior cause reversing the polarity of the inductors of the dynamo-electric generator so as to cause it to give birth to a reversed current. This reversal is proved by placing a compass near the inductors, and this reversal keeps time with the reversal of the current, as shown by the galvanometer in circuit with the machines.

Let us suppose that the magneto-electric receiver has periodic increases of velocity. These will give rise to a current of its own in the magneto-electric machine, which will traverse the dynamo-electric machine, and, as it will be a contrary current to that coming from the latter, it will tend to reverse the polarity of the inductors of the dynamo-machine. Hence a reverse current will proceed from the latter.

To test this hypothesis it is sufficient to prevent the increase of velocity in the magneto-electric receiver by means of a brake. As soon as the brake is put in play the paradoxical effect vanishes, and the receiver goes uniformly in the same direction, whilst the galvanometer and compass are unaffected. The experiment is well shown by a Siemens dynamo-electric continuous current machine for generator, and a small laboratory Gramme with ordinary permanent magnets, as constructed by M. Breguet, for receiver.

THE NEW UNIVERSITY.

The north of England is to have its own university in future, and the central college is to be at Manchester. The charter of Victoria University, as the institution is called, confers the right to give degrees and honorary titles in all those departments of learning which are similarly recognised at the other universities of the United Kingdom, with the single exception of the faculty of medicine. This deficiency is, however, to a certain extent, supplemented by the existing medical school at Owens College, Manchester; but, nevertheless, it is not unlikely that in course of time the missing faculty will be bestowed upon Victoria University. Owens College, which is the germ of the new institution, is pre-eminently a scientific school, just as Cambridge is mathematical and Oxford classical. It is, therefore, probable that it will be principally in the direction of natural science that the new university will develop, that is the direction in which there is least competition and most room for progress. Moreover, a high and well-equipped scientific college is not only a *desideratum*, but a necessity of the times; and though it is, to say the least, questionable whether an experimental training in natural philosophy affords a spiritual culture as beneficial and effective as the older literary and mathematical curriculums, there can be no doubt that, for a certain class of mind, it is the best mental discipline. Electricity has now become so prominent an agent in the world that the foundation of a course of electrical engineering is almost incumbent upon the authorities of the university, and we should like to see it instituted with a suitable titular degree, or, at least, a certificate for successful students.

THE ROYAL ENGINEER TELEGRAPH TRAIN AT ALDERSHOT.

The Royal Engineer Telegraph Train, under the command of Major A. C. Hamilton, lately returned from the Zulu campaign,

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offers a gratifying instance of the smartness and efficiency attainable by our scientific corps from frequent and actual practice in the field. The equipment of the train is contained in twenty-four wagons, each drawn by four horses, carrying two drivers, and attended usually by a non-commissioned officer and six men on foot. Six of the wagons are coaches fitted up as signal offices, and two others each carry a boat for crossing deep water that may be met with. Thirty-six miles of india rubber-covered copper strand wire, the core 0·3in. in diameter and braided with hemp, for running out on the ground, and thirty-four miles of bare copper wire (No. 22, Birmingham wire gauge) for aerial line, are carried on drums. Each drum contains half a mile of core, and six drums can be carried in the body of a wagon, revolving on fixed axes. Under the drums are kept twenty telescopic iron gas pipe standards, 18ft. long, for erection at road, stream, and canal crossings; three log-line stays with iron spikes and wooden cleats are supplied to each standard for straining it taut, and a small wooden top-piece to contain the covered wire, with a wedge to hold it tight. On actual service any length of aerial line of copper or thin iron wire can, of course, be run up, and trees, bamboos, or such jungle props as can be got locally would be employed as supports. This aerial line would follow in the rear of an advancing force, while the covered core would serve for running out on the ground to connect flanks with the main body and the latter with the rear and camp. In crossing an open country the ground line is run out at the respectable rate of five miles an hour, inclusive of stoppages for erection of pairs of telescopic poles at road crossings. While the wagons are on the move and the wire is being paid out, the men busy themselves in putting it out of harm's way as much as possible—inside hedges and fences, behind furze bushes, over palings, on the roofs of cottages, or in trenches at road crossings where the length of the poles is insufficient. When the wire is to be re-coiled the wagon turns back over the same route; an india rubber endless band is passed over the axle of the drum and over that of a wheel concentric with and fixed to the hind wheel of the wagon, so that as the latter progresses the wire is coiled on the drum; and a man walks behind letting the wire pass through his hand (covered with a leathern glove) to remove kinks and to guide it on to the drum. The receiving instruments for the offices are "direct ink writers" or tape recorders, consisting of a lightning protector, a key or handle, a galvanoscope, and a polarised sounder resembling a Siemens relay turned on its side with the tongue horizontal; this is connected with the usual clockwork arrangement for paying out the tape. These instruments will work through fifty miles of the wire used, but for field work are unnecessarily cumbersome and complicated; greater speed of transmission would be obtained were the men taught to read by sound, at a rate not less than fifteen words per minute, from a small simple or polarised sounder. Such an instrument, of 200 units resistance, would work through 200 miles of wire, with a small battery power, and would certainly be cheaper and more portable than that in use; and the time now expended in translating the messages from the tape record would be saved. The battery cells used are those of the Leclanché "gravity" form, and are fitted into ordinary wooden troughs; one chamber contains zinc and a solution of sal ammoniac, the other carbon and peroxide of manganese; sawdust well packed into the tops of the cells prevents spilling of the solution. These batteries are worked on the "closed circuit" system, and it is a question whether small-sized Daniell cells in troughs, excited by sulphate of copper, sal-ammoniac, or common salt where obtainable, would not be found more constant for a continuous current.—From *The Times*.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).

The half-yearly general meeting of the shareholders of this Company was held on the 6th inst.

The SECRETARY (Mr. T. H. Wells) read the notice convening the meeting, and the minutes of the last general meeting, which were confirmed by the present meeting and signed by the chairman as correct. The report, which appeared in *The Electrician* of last week, was taken as read.

The CHAIRMAN, in moving its adoption, said it occurred to him to say that many things had happened since they last met. Considerable changes had occurred in the political aspect of the country, as to which they all had their own opinions, and were entitled to them, but he thought there could be but one feeling, of satisfaction and thankfulness, at the change which during the same period had to some extent occurred in the commercial and agricultural condition of the country. He did not think that anyone could say with truth as yet that we had entirely emerged from the period of commercial depression which had so long oppressed us, but they could see on all sides evidences of the beginning of a new period, which he hoped would be a long one, of commercial prosperity. That could not fail to affect the Company in a very material degree, because the result of the events of the past few years had established beyond question the fact that telegraphy had now become as necessary to trade and commerce as money or credit, by which trade and commerce were conducted. When he last addressed them they had just commenced the preparations for a competition with the new company in France. Their position with reference to the receipts of their Company, from their traffic, he was not then able to communicate to them in detail—he referred to the current receipts; but he ventured to tell them that they need not be unhappy as to the result of them. He thought that the report for the half year then before them proved that his prophecy on that occasion was well founded, and he also thought they had come well through the half year's transactions. The competition in which they were now engaged was, as far as he was concerned, an illustration of how a perverse destiny pursued a man, and how little effect on his conduct in public might be his private opinions. He held, in commercial matters as well as in politics, that war, when not a necessity, is a great crime; but, unfortunately, notwithstanding the strength of his conviction on that subject, during the last ten years, the greater part of which he had been chairman of that Company, they had scarcely ever been in a state of peace. They, however, all understood as well as he did that that had not resulted from their own action, that they were acting in every case purely on the defensive, and that they were merely protecting the Company's interest from aggression, which he did not mean to say was disgraceful in any way to those who made it. They had merely, however, to protect the Company's interests from aggression, but not engage in useless or unnecessary contests with other people. He had only to say, with regard to the present contest, that, like all justifiable wars, it was only carried on for the sake of producing a permanent and advantageous peace, and that the directors were perfectly prepared, whenever terms which they considered conducive to the interests of the Company were offered to them, to conclude immediately such a peace, always assuming that they had grounds for supposing that it would be permanent and advantageous. So much for the competition on which they had been engaged as regarded its external aspect. He might tell them that, with respect to its effects on their internal economy, so to speak, they had derived a good deal of most useful information from it. They had never before had a low tariff in operation for so long a period, and whatever its effects might be financially, there was no doubt that those who practically managed the Company's affairs—and his hon. friend beside them, their managing director—would derive for their future guidance a great deal of useful information from the results of the traffic of the last three or four months. He announced to them when they last met that they had entered into a contract for the construction of a new cable between America and Ireland. That contract was now in course of completion. It included, as they were aware, the relaying of a good deal of their inter-island cable between Newfoundland and the adjacent continent of America; and a great portion of that part of the contract had been completed. The expedition to lay the main cable had sailed, and they might hope in the course of a few days to receive information of its successful completion. He thought he might congratulate them on this circumstance. They were laying a new cable, of the most approved type, with every new invention applied to it—one which they might expect would be more durable even than those which they already possessed—and the Board were doing that on their behalf, without asking them or the public to contribute a single shilling towards the expense. He had sometimes had contests to a certain extent—carried on with great good humour on that side of the room—with certain members of the shareholding body, with respect to the propriety of laying by a good reserve fund. They were now, however, enjoying the benefit of that policy. They were acquiring an implement which would perpetuate their Company, which would perpetuate the means for carrying their traffic, which would enlarge their means of carrying the traffic, if that was necessary, without incurring additional expense, and he thought that that was a subject of congratulation on the part of the Board when they met the shareholders at their half-yearly gathering. It was unnecessary for him to say that, in examining and explaining the accounts, as he generally did for their satisfaction, it would be impossible to institute any such comparison between the accounts of that half year and the accounts of previous half years. He said that for two reasons. They would see by the report that the receipts for the half year had been diminished by the competition he had referred to to the extent of something like £20,000. Well, it would, of course, be very unfair to find fault with the receipts of that half year on account of that diminution. They were the natural results of adopting a very low tariff, and that tariff was necessary for reasons they all understood. On the other hand, the reduction of the tariff led to an enormous increase in the number of the messages, and that increase involved the employment of additional hands to do the increased work. They, therefore, had in their accounts the same causes producing a diminution of income, and an increase of expenditure. That, however, was inevitable. It was impossible to do about double the work with the same number of hands, and they could not expect in a couple of months to raise the amount of their messages so as to replace the sacrifice involved in reducing their tariff from 3s. to 6d. a word. He had stated this broadly, and they would find if they examined the accounts that the statement he had made would account for almost the whole of the increase in the expenditure of that half year as compared with the expenditure of the corresponding half year of 1879. There was just one item he would allude to, because when he looked into the accounts it deceived him, and, therefore, might deceive others—he referred to the sum charged for repairs of cables. The sum so charged up to the 1st of July, 1879, was £14,429, but if they looked on the opposite side of the accounts they would find "charter of steamship 'Minia,' £8,100." The sum charged in the accounts up to the date now under consideration for the repair of cables and attendant expenses was in the whole £15,444 for the half year. That showed that they had spent about £1,000 more this year than last, but that did not give them exactly how the case stood, because the £8,100 for the steamship "Minia" was paid to them by their friends of the Direct Company. The repairs charged to the debit side of the account were repairs to the Direct Cable, and the Company were paid for them, so that in point of fact though £14,000 odd was put down £8,000 was paid back. That was all he had to say with regard to the accounts, but there was one matter he could not sit down without alluding to, and he was sure it would command the sympathy of all present. They missed at that table a face which had been familiar to the supporters of American telegraphy from its first inception—he referred to the late Captain Hamilton, who was connected not only with the Board of that Company, but with American telegraphy from the beginning of the enterprize.

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They had lost him, and had lost a gentleman who to his own knowledge devoted himself as long as health and strength permitted to the service of the Company with great assiduity, and great beneficial effects to the Company. He could not allow that occasion to pass without making that allusion to him, and he was sure it would command the sympathy of every gentleman in the room. He then moved "That the report of the directors and the accompanying statement of accounts submitted to this meeting be and they are hereby received and adopted."

The Hon. ROBERT GRIMSTON seconded the motion.

Mr. SEELEY observed that the accounts showed that, as compared with the corresponding period of 1879, there was a deficiency in the receipts of £19,000 odd, but as compared with the preceding half year the deficiency amounted to £125,000. As to the 200 miles of cable in stock, which they were going to use, did the value of the amount they took represent the £73,000 shown in the accounts? In the general balances the cable was represented at £81,000, while in the other balance it was represented as £73,000. He would like to know the addition in the number of messages they had been passing through the cables since the reduction of the tariff, the number in the month of June last as compared with June, 1879. It would be very gratifying to know that the amount assimilated in value to preceding years.

Mr. HALSALL asked whether it was intended to give up the weekly reports of the takings? It had been very gratifying, more particularly when the takings were continually showing an increase each week, to see how they were going on, but since the competition had been going on they had been kept quite in ignorance on the matter. He would also remark that the amount transferred to the reserve fund last half year, instead of £75,000—half the £150,000 which it was understood was to be the amount appropriated to the reserve fund—was £140,000, or £65,000 more than they had a right to expect from the previous arrangement.

Mr. WILLIAM ABBOTT remarked that no one was more jealous than he of the rights of shareholders, but at the same time he thought that, under present circumstances, and seeing the delicate negotiations now going on with their French competitors, it would be most unwise to give the information asked for by the hon. proprietor. He thought after so many years' experience they might safely leave all these matters in the hands of the Board. He would be extremely sorry if, through any indiscretion on the part of any hon. proprietor, they were to give information which might be used against them either by the French Government or the French Cable Company. He impressed on the Board the importance of showing on the next occasion that the £500,000 they were taking from the reserve fund for the purpose of the new cable had been so taken. They were drawing it from the reserve fund, but were investing it in the very best reserve fund they could possibly have, a new cable; but at the same time the money was taken from the reserve fund, and would disappear, and he therefore hoped that next time the amount would appear as having been invested in a new cable. Sometimes remarks had been made that the capital had been "watered," but if the suggestion he had made were acted on every one would be able to see that the capital had been "thickened" from time to time. He congratulated the addition to the Board of their very able manager, Mr. Henry Weaver. That gentleman had had experience in telegraphy long before many of them thought of entering into it, and if he remembered aright Mr. Weaver had been in several telegraph fights. He was a born fighter where the interests of his colleagues were concerned, and he was very pleased to see him occupying his present position.

Mr. WILDY said he would like to ask if there were any negotiations going on with the rival company. There was rather a hazy paragraph in the report—paragraph 15—which he had read two or three times. He did not know whether that meant that they might not safely go to two shillings a word, and so compete with the French company on their own terms. He asked the Chairman not to reply to his question unles he thought it were prudent to do so.

Mr. STEPHENS asked a question as to the dividend warrants. He believed it was the uniform practice of joint stock companies that cheques should be signed by two directors and countersigned by the secretary. If that were not done what security had they against malpractices? No doubt it was a question which concerned the directors more than the shareholders, but still he would like to have an assurance on the subject.

The CHAIRMAN, in reply, said they would use, in laying the new cable, every mile of their spare cable that was fit for the purpose, but a certain portion of it was of a type different from deep sea cable. They were utilising the shore ends of the 1866 cable, and the cable they had in stock would be used as far as possible. It amounted, in round figures, to about half of what they had. As to the question of the amount of traffic they had been carrying, perhaps he might answer it and the question put by Mr. Wildy at the same time. He did not think just at that moment, to use a House of Commons phrase, that the public interests would be served by disclosing too much of what they (the Board) knew; but he might tell them that the duplex system—he had the authority of the managing director to say it—enabled them to carry on each cable double what they did before. They had three cables in full operation, and in a few days they hoped to have a fourth, and they could carry on those cables as much as they could on eight cables five or six years ago. That statement he thought ought to satisfy them. He believed that the duplex system had really increased the carrying capacity of their cables 100 per cent. With regard to the question about publishing the daily reports of their returns, it came precisely under the same rule as the question of Mr. Wildy. The daily report was suspended simply and solely as part of their fighting measures, and he need not tell them that that Board of all boards had never kept anything secret from their proprietors which they could have told them with advantage, and as soon as the fight was over they should have every information as freely as before. As to the dividend warrants, they were signed by the secretary and countersigned by the registrar, and they were a check on one another. The cheques, too, were crossed, and were paid out of a special account of the Company's at the bank. He thought the gentleman who asked the question was not thoroughly informed of the general practice of joint-stock companies, for he (the chairman) happened to belong to another institution which was not a telegraph company, and their dividend warrants were paid in exactly the same way. It must be remembered that the Company paid quarterly dividends, and the labour of getting them out was very great, but they took such precautions as they thought would render the matter perfectly secure. After ten or twelve years' experience, too, they had never experienced any difficulty in the matter, and he thought they might go on with the usual practice. As to the sum put to the reserve fund last year, at their last meeting the proprietors fully sanctioned, without a dissentient voice, the appropriation to the fund of an exceptional amount, and the object of that was to put them in funds for the purpose of fighting. It was put forward as an exceptional matter, and they could see from the way they had dealt with the subject this half year that it was exceptional, and that they did not mean to do it in future. They would take care that Mr. Abbott's suggestion (to show in the next accounts that £500,000 of the reserve fund was invested in the new cable) was not forgotten.

Mr. JOHN NEWTON asked whether the cables which were carrying 100 per cent. more traffic than before were sustaining the work as well as before—as they were doing double the work they did before, were they being injured in any way, or did they do the double work and remain in an equally satisfactory condition?

Mr. JACKSON said that he understood the chairman to say that the last cable was a better type than the others. He suggested on a former occasion specially coating the sheathing of the cables, so as to render them more durable, and he should like to know whether there was anything special about the sheathing of the present cable that would render it more durable than any of the others. He regarded that question as a most important one in the interests of the shareholders.

The CHAIRMAN expressed his obligations to Mr. Newton for having asked his question, as it enabled him (the Chairman) to give such a perfectly satisfactory answer as he was about to. The effect of the duplex was not to increase the wear and tear in the slightest degree. The cables carried double the number of the messages they used to, and were not in the slightest degree injured by the process. As to Mr. Jackson's question, he told that gentleman either at the last meeting or the one before, when he raised the question, that they were having experiments of every sort carried on. He really did not think it was at all desirable that they should make known how their cables were constructed. The cable now being laid was the result of a very drastic system of experiment, and its construction was such as had been justified by those experiments. They believed that both in cable power, and probably in durability, it was the best cable ever put at the bottom of the sea. He then submitted the motion, and it was carried unanimously.

Mr. WILDY then proposed a vote of thanks to the chairman and directors for their attention to the business of the Company.

Mr. WILLIAM ABBOTT seconded the motion, and it was carried unanimously.

The CHAIRMAN said he should, as on former occasions, venture to move an amendment—that the officers should be included in the vote. They could do very little without the assistance of those gentlemen, and on their behalf, as well as on the part of the directors and himself, he begged to return them their sincere thanks.

The proceedings then terminated.

WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).

The fourth ordinary general meeting of the above Company was held on the 6th instant, at the City Terminus Hotel, Mr. Neil Bannatyne presiding.

The SECRETARY (Mr. F. L. Robinson) read the notice convening the meeting, and the directors' report, which has appeared in *The Electrician*, was taken as read.

The CHAIRMAN said there was nothing of importance for him to detain them with in addition to the particulars with which they had been furnished in the report. They were very much in the same position as when they met last time. The warwas not yet at an end, and although, so far as one could form an opinion, it was probably much nearer its end than it was six or four months ago, until it was really ended they could not look for any very great improvement in their traffic receipts, which constituted the main feature of their affairs. They might be interested to know the position of their cables at that moment. The Autofagasta-Iquique section was repaired by the Company's steamer on the 1st of December last, re-establishing communication between Iquique and Valparaiso, but the sections north of Iquique were still interrupted—Iquique-Arica, Arica-Mollendo, Mollendo-Chorillos. These sections had been cut by the Chilian war vessels. They had made a claim on the Chilian Government for the amount of traffic lost in consequence of these interruptions, and also for the expense which must be incurred by the Company in repairing the cables. They had not received an official and definite reply to their claim, but they were in correspondence with their representative abroad, and were urging him to take all means to get an early settlement of at least such portion of the claim as would accrue to them up to the 31st December last. There was nothing else in the accounts or the affairs of the Company which called for any further observation from him, and he concluded by moving the adoption of the report and accounts for the year ending the 31st of December last.

Mr. JOHNSTON seconded the motion.

Dr. BEATTIE said he was not able to be present at their last meeting, and he observed that since then they had increased the number of the directors to the full number—five. He wished to know whether they had done so under clause 37 of the articles of association. He would also wish to know, if the solicitor were present, whether the election required confirmation by the shareholders. He was not making any objection to the increase in the Board, but was simply asking for information, as he thought the articles of association were rather loose.

The CHAIRMAN said that Dr. Beattie was proceeding on a wrong basis altogether. Mr. Kendal was elected at the last general meeting, and it appeared to the Board that they had only that course to take. Mr. Kendal was chosen by a majority at that meeting, and their duty clearly was to ascertain what was their legal position, in order that they might not be blamed afterwards for anything they did. They therefore took the advice of their lawyer, who took the opinion of counsel, and the result of that opinion was that Mr. Kendal was elected by a general meeting. They were advised that Mr. Kendal was legally elected a member of the Board, and

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they were not going to take the invidious position of resisting the decision of the meeting, which, too, had been confirmed by their own legal advisers.

The SOLICITOR stated that clause 24 of their articles of association said that the shareholders might, at any ordinary meeting, elect directors. If clause 41 were thoroughly examined it would be found that it applied only in cases of a director being elected in place of a retiring director, not where there was a vacancy and the number had to be filled up.

Dr. BEATTIE asked whether it was necessary that the nomination should be confirmed at the next general meeting?

The SOLICITOR: That is not necessary.

Dr. BEATTIE held that that was an omission in the articles of association. In his opinion there was an inconsistency in the 24th and 41st clauses. He wished to be understood that he was not protesting against the gentleman who had been elected, but he was acting in order to obtain information, as at the next general meeting he intended to propose that no shareholder should be admitted as a candidate for a seat at the Board unless he had held absolutely in his own right the qualified number of shares, one hundred, for at least three months. He also trusted that the directors, who were so conversant with the articles of association of other companies, would see the necessity—at all events, the propriety—of requiring that the appointment of any director should be confirmed by the shareholders at a public meeting. That was the usual way, and he thought it only a proper deference to the shareholders that that confirmation should be made.

The CHAIRMAN said he might just state that Mr. Bristow informed him that that was really an alteration of the articles of association, and would require two meetings to carry out. As an alteration was proposed the Board might take the opportunity to look over the articles of association and see if there was any other point that required putting straight at the same time. He then put the resolution, which was carried unanimously. Continuing, he stated that that was all their business, and he hoped that the next time they met it would be under more auspicious circumstances, that there would be peace on the West Coast, and increasing traffic. They had no reason to doubt that there would be increasing traffic as soon as things were fairly settled again.

On the motion of Dr. BEATTIE a cordial vote of thanks was passed to the chairman and directors.

The CHAIRMAN said that although the Company did not give them much work there was much anxiety with the concern, as they could well understand when their cables were being cut, for they did not know from one fortnight to another what their real position was.

The meeting then separated.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES AUG. 11.		BUSINESS DONE WEEK ENDING AUG. 11. Highest.	Lowest.
Anglo-American Ordinary	63¾,	64¼	65	63
Do. "B"	95⅞,	¾	96⅝	93
Do. "A"	35¾,	36¼	37⅞	36
Brazilian	9,	⅛	9 1-16	8⅞
Cuba	9¼,	¾	9¾	9¼
Do. Ten per Cent. Pref.	16,	17	—	—
Direct Spanish	1¾,	2¼	—	—
Do. Ten per Cent. Preference	11¼,	⅜	11½	11⅜
Direct United States	12⅜,	⅝	13	12¼
Eastern	9¾,	⅞	9⅞	9 7-16
Do. Six per Cent. Debenture	103,	106	103¾	103¾
Do. Five per Ct.do.1899	102,	105	104	103
Do. Six p Ct. Pref.	12⅜,	⅞	12¾	12½
Eastern Extension	9¾,	⅞	9⅞	9⅜
Do. Six per Ct. Deb	105,	108	107½	106½
German Union	9½,	¾	9⅝	9¼
Globe Telegraph & Trust	6 11-16,	13-16	6 15-16	6 11-16
Do. Six p Ct. Preference	12⅜,	⅝	12⅝	12¼
Great Northern	9½,	¾	9 11-16	9 9-16
Indo-European	24½,	25½	24⅜	24⅜
Mediterranean Extension	2¾,	3¼	3⅛	3⅛
Do. Eight per Cent. Preference	10¾,	11¼	11⅛	11
Reuter's	9½,	10½	10¼	10¼
Submarine	247,	253	251	251
West India and Panama	1 9-16,	11-16	1 9-16	1⅛
Do. Six per Cent. 1st Preference	7½,	½	7½	7½
Western and Brazilian	7,	¼	7⅛	7
West. Union 7 p.Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	105½	105

TRAFFIC RECEIPTS FOR JULY, 1880.

COMPANIES.	July, 1880.	July, 1879.	Incrse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,800 estd.	2,932	—	132
Direct Spanish Telegraph Company	1,423	913	510	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	45,279	35,789	9,49	—
Eastern Extension Telegraph Company	32,194	23,411	8,7	—
Great Northern Telegraph Company	23,560	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

ADDRESSES.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD STREET, LONDON, E.C.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane.

NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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SLIP

THE ELECTRIC LIGHT IN THE CITY.—Tenders are invited for the necessary apparatus to light several City bridges and streets with electricity.

CHICAGO.—The City Council is considering the necessity of placing all telegraph and telephone wires in the ground. A committee has been formed to report on the subject.

DUPLEX TRANSMISSION.—An interesting article by M. Kovacevic, on "Duplex Transmission with two Relays," is commenced in the issue of the *Journal Télégraphique* dated July 25.

CABLE COMPANY SHARES.—It will be noticed that last week the ordinary shares of the Eastern Telegraph and Eastern Extension were quoted at par, the first time this has occurred for several years.

REMOVAL OF A POST OFFICE TELEGRAPH DEPARTMENT.—The *Civilian* believes it is proposed to remove the Telegraph Message Branch, now located in Blackfriars-road, to the premises in St. Paul's Churchyard just vacated by the Savings Bank Department.

THE SOCIETY OF TELEGRAPH ENGINEERS.—We would remind foreign members of this Society that their opinion upon the proposed change of title should be posted so as to reach London by the end of October, the general meeting to decide the question being announced for November.

EXPORTS.—During the month of July, 1880, the value of telegraph wire and apparatus exported amounted to £229,640, as against £287,116 in the corresponding month of 1879. The value for the seven months ending July 31st, 1880, was £646,116, as against £849,687 during the corresponding period of 1879.

A NEW LUMINOUS EFFECT PRODUCED BY ELECTRICITY.—By causing the brush discharge from an electrical machine to traverse an atmosphere of fluoride of silicum, MM. Hauteville and Chapuis have, it is stated, obtained very brilliant luminous effects, constituting a striking lecture experiment, and probably susceptible of otherwise being utilised.

GUTTA PERCHA AND INDIA RUBBER.—The price of gutta percha as quoted is—genuine, per lb., 9d. to 2s. 6d.; reboiled, 3d. to 1s. India rubber is quoted—Para, fine, 3s. 5d.; negro head, 2s. 6d.; Central American, 2s. 2d. to 2s. 6d.; Assam and Pegu, 1s. to 2s. 5d.; other East Indian, 1s. 9d. to 2s. 5d.; Madagascar and Mozambique, 2s. to 2s. 6d.

IMPORTS OF GUTTA PERCHA.—In the seven months ending July 31st, 1880, no less than 46,003 cwt. of gutta percha have been imported, as against 27,038cwt. in the corresponding period of 1879, the value respectively being given as £368,525 and £215,239. The value of the percha imported in July was £43,824, against £44,003 in July of last year.

INDIA.—Mr. B. C. Bailey, superintendent 1st grade Indian Telegraph Department, retires on a pension from June 19th. In consequence of this retirement, Mr. C. B. P. Gordon has been promoted from 2nd to 1st grade superintendent, Mr. J. M. Lane from 3rd to 2nd grade superintendent, and Mr. J. C. Douglas from assistant-superintendent 1st grade to superintendent 3rd grade.

ENTERTAINMENT TO MEMBERS OF THE CANADIAN GOVERNMENT.—"Mr. John Pender, M.P., entertained last week at his country residence, Foots Cray Place, Kent, the Right Honourable Sir J. A. Macdonald, Premier of Canada, and the other members of the Canadian Government now in London, about the construction of the Pacific Railway. Several noblemen and gentlemen were invited to meet the distinguished guests."—*Morning Post.*

"SAVING AT THE SPIT."—If the Indian Government have been spending at the military bunghole they appear to be sufficiently economical at the telegraphic spit. In a telegram just published from the Viceroy, explaining to the home authorities some obscure item of estimated improved resources, we notice the following parsimonious phrase, "betterness public works explains part."

ELECTRICITY AFFECTED BY A MAGNET.—The phenomenon recently described of the action of a magnet in altering the path of a current of electricity in the conductor which carries it, has formed the starting point for two investigations, which have appeared separately in the *Wegner Anzeiger*, by Boltzmann and Von Ettingshausen respectively, in which they point out that this discovery may be applied to determine the absolute velocity of electricity in a conductor.

MAGNETIC STORM.—The French Minister of Posts and Telegraphs has issued a notice, informing the public that any delay which may have occurred in the transmission of telegrams on the 12th and 13th instant was due to a magnetic storm, influencing the telegraph apparatus in many parts of Europe. Besides France, England, Belgium, Switzerland, Germany, Norway and Russia were specially affected by this phenomenon. On the 14th the telegraph service was in perfect working order.

THE ELECTIC LIGHT.—So satisfied have the Great Eastern Railway Company been with the electric light at their Liverpool-street terminus that they have increased the number of lamps from 16 to 31. Three of the new lamps are outside the station, one being close to Liverpool-street, a second at the foot of the approach to the main line, and a third on the approach to the suburban booking offices on the higher level. The system is also extended into the booking offices, and instead of being confined, as heretofore, to the main platform, has now been carried to the suburban platforms also.

THE DIRECT CABLE COMPANY.—Our friends across the Atlantic seem only just to have heard of the successful duplexing of the Direct Atlantic Cable, for the *Montreal Daily Witness* of August 3 says:—"The Direct Cable Company announce that they have secured a duplex system of working their cable, and that it is in use between the hours of three and six p.m. Greenwich time, corresponding with ten a.m. and one p.m. New York time, by which means they have practically two cables working during these important business hours, enabling them to give business extra despatch. Replies, it is said, are frequently received from Europe in fifteen and twenty minutes."

"NO NEWS IS GOOD NEWS."—We are spitefully reminded of this old saying in connection with the over hasty telegram which startled all London the other afternoon for several hours, announcing the loss of nearly a thousand lives at sea. Had there been no means of communication with Aden except the post, it would have informed us of the safe arrival of the deserted pilgrims at the same time that it brought us the by no means equally welcome intelligence that the captain and his party had taken particular care to save themselves. No news, however, is sometimes bad news, and we may charitably suggest that if the telegraph gave as full details as the post, the captain's conduct would not be thought so bad as it looks.

ATMOSPHERIC ELECTRICITY.—A paper on this subject was recently read before the Academie des Sciences by M. Mascart. His observations at the College of France are made with a Thomson quadrant electrometer, the deflections of the needle being transmitted to a pencil. The two pairs of quadrants are kept at equal potentials of contrary sign by two poles of a battery which communicates with the ground; the needle is connected with a vessel letting flow a continuous stream of

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water into the outer air. Generally the potential of the air, always positive, is found much higher and more uniform by night than by day. From 9 p.m. to 3 a.m. it varies little, falls at daybreak, reaches a minimum about 3 p.m., then rises rapidly to a maximum about 9 p.m.

THE OBSERVATORY ON MOUNT ETNA.—A correspondent of the *Daily News* writes:—"I have received the following from Professor Silvestri, of Catania:—'In a short time the Observatory on Etna will be an accomplished fact. The Italian Government contributes half of the expenses, the Province of Catania a fourth, and the Commune of Catania the remaining fourth. The object of the Observatory is the study of vulcanology, and therefore it has been built at the base of the central cone, exactly on the former site of the well-known refuge called the "Casa degli Inglesi." It will be in connection with several small sismic stations posted on the slopes of the mountain, and the whole will communicate telegraphically with another vulcanic station which I propose to establish in Catania.'"

THE ELECTRIC LIGHT IN WARRINGTON.—The electric light is about to have a fair trial in Warrington, at the new works in course of erection for the *Guardian*, opposite the entrance to the Town Hall, so well known for many years as the residence of Lord Winmarleigh. The new building is peculiarly adapted for the electric light, as it is but one storey, covers a space 150 by 93 feet, and has its inside walls lined with white glazed bricks, which will materially reflect the light. The arrangements comprise two Gramme machines, giving light to four burners, each 4,000-candle power. These machines will require about ten-horse power to drive them, which will be found by steam or gas engines, both being provided for the new works. The work is being carried out by the British Electric Company.

AURORA BOREALIS.—A fine aurora borealis was visible at Bridlington on Wednesday night, bearing between north by east and north-north-west. The streamers were 30 degrees long. The Rev. A. S. Page, vicar of Selsley, writes from Selsley Vicarage, Gloucestershire, under date August 12:—"Last night, from 11 to 11:25, while looking for meteors, we had a beautiful display of aurora borealis. The light was of a greenish white tint, suffused over the north. From it shot out streamers of white light reaching sometimes as far as the Great Bear. Selsley is 9½ miles due south of Gloucester, which is in lat. 51 54 N., long. 2:15 W. We saw many meteors."—Mr. F. J. Minasi writes to *The Times* from Compass-cottages, Ilfracombe, under date August 13:—"Your scientific readers may like to know that a vivid display of the aurora borealis was seen here last night. It was first noticed about 10:15, when a bright arch appeared beyond the Welsh coast, extending over nearly 40deg. of the horizon. From this darted bright streamers towards Stella Polaris, with others in a parallel direction."

CINCINNATI.—A company, the capital stock of which is chiefly owned here, is negotiating with the cable companies for the lease of a line for eight days for the purpose of testing experiments for telephonic communication with Europe. It is believed that the new French line will be secured. The arrangements, it is thought, will be completed in a few days. The process upon which the proposed work is to be done is based upon the Oranbough invention of 1868 and the recent Klemm patents. Ample capital has already been raised for completing the plan. Several Eastern influential business men are associated in the enterprise. The tests will be made from New York City. Only the combination of the two systems mentioned will be tested, to the exclusion of the Bell, the Edison, or any of the instruments now in active use, as the new company claim that the other companies are actually infringing a prior invention, and the question will probably be tested in the courts. It is said that six of the most eminent patent lawyers of the United States have been already retained by the Cincinnatians. The capital raised for the experiment is 500,000 dollars.

CUTTING TELEGRAPH WIRES.—The destruction of the telegraph wires as part of the plot for carrying off arms from the vessel lying in Cork Harbour reminds us that this kind of outrage is now becoming common not only in warfare but in times of public disturbance. Uncivilised communities are discovering that the operation which formerly afforded them mere amusement is one that may be turned to serious account against the enemy; and in Ireland it has long been practised to embarrass the representatives of law and order. It is suggested that wires connecting military stations, especially those on active service, and in all times of civil excitement, should be permanently charged so as to give off a signal at the moment of breakage. With a suitably-constructed alarum the expenditure of a very small amount of battery power would suffice for this purpose; and in most cases the conditions under which the interruption might occur would indicate whether it is due to accident or violence. If breakage cannot be prevented, it would be something to have prompt notification that mischief is brewing, and in what quarter; moreover, the knowledge that wires cannot be cut without their instantly telling tale would act to some extent as their protection.

OVERHEAD STREET WIRES.—A correspondent, writing in reference to our recent article on overhead street wires, informs us that in the heart of the City of London there is a housetop erection from which radiate in several directions upwards of 200 telegraph wires. A fourth of these cross the street in slanting directions; their span is consequently very long, and a downfall would sweep the traffic not only in that particular street but in two busy thoroughfares which bisect it. Of the remaining wires about 120 are carried at something approaching right angles, but extend across a second and busier line of traffic running parallel. Most of these latter, if they fell, would be arrested by the intermediate housetops; but in the case of a large number of them their route is directly over a bye street connecting the two main thoroughfares, and breakage in this direction of any one wire would mean the descent of at least 50 yards, and possibly 100 yards of it upon the traffic below. Our informant suggests that streets should be spanned at right angles, and that either by extra elevation or extra poles at shorter intervals no wire should be capable of reaching the ground unless it broke in two places, which is a very remote contingency.

THE BRITISH ASSOCIATION.—The 50th annual meeting of this Association will commence at Swansea on the 25th inst. The President-Elect is Mr. Andrew Crombie Ramsay, LL.D., F.R.S., V.P.G.S., Director-General of the Geological Survey of the United Kingdom and of the Museum of Practical Geology. The first general meeting will be held on the day named, at 8 p.m., when Professor G. J. Allman will resign the chair, and the President-Elect will assume the presidency and deliver the inaugural address. On the 26th there will be a *soirée*; on the 27th, a discourse by Professor W. Boyd Dawkins on "Primeval Man;" on the 30th Mr. Francis Galton, M.A., will lecture on "Mental Imagery;" and on the afternoon of the 1st of September the concluding meeting will be held. On the evening of the 28th (Saturday) Mr. Henry Seebohm, F.Z.S., will deliver a lecture to the operative classes on "The North-East Passage." There will be various excursions during the

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meeting to places of interest in the neighbourhood of Swansea. The sections will be as follows:—Mathematical and Physical Science (President, Professor W. Grylls Adams); Chemical Science (Mr. Joseph Henry Gilbert, Ph.D., F.R.S.); Geology (Dr. H. Clifton Sorby); Biology (Mr. A. C. L. G. Gunther, M.A.); Geography (Lieutenant-General Sir John Henry Lefroy, C.B.); Economic Science and Statistics (Mr. George Woodyatt Hastings, M.P.); and Mechanical Science (Mr. James Abernethy, V.P. Inst. C.E.., F.R.S.E.).

Improvement of the Gramme Magneto-Electric Machine.—Where a continuous current is required, the Gramme machine is in our view not only equal but even superior for purposes such as electric lighting to any other generator of electricity; and this development of the Paccinoti ring has appeared to be in principle and detail so perfect that no inherent defect has hitherto been pointed out. We think, however, that theory indicates a shortcoming which is stated to be of very considerable practical moment, and which will probably be remedied by an invention which will shortly be made public. The distribution of magnetism in the soft-iron ring is very far from being in the direction generally assumed, viz., in the annular direction of the ring itself, which is that in which the inductive effect would be a maximum. The ring being placed between the poles of a magnet, the normal magnetic effect tends to take place in a straight line uniting the poles; and although this direction is considerably modified by the peculiar form of the armature in this case, it is stated that experiment as well as theory indicates that the magnet produced by induction is by no means generated in a line at right angles to the general direction of the wire in the coils upon the ring. The loss of effect from this cause would appear to be considerable; and if this be the case the Gramme machine, as well as others in which a soft-iron ring is employed, may very probably be susceptible of considerable improvement.

An Engine for Edison.—There is now, says the *Ironmonger*, in course of construction at the Southwark Iron-foundry, Philadelphia, an engine upon the result of the workings of which a great deal is staked relative to the success or failure of the electric light of Professor Edison. In making his numerous experiments with the light, Mr. Edison found great difficulty in procuring an engine that would run the dynamo-electric machine sufficiently fast and steady to produce a good light. Up to this time none could be found, and the desired revolutions have been made up in a manipulation of belting. This has proved decidedly unsatisfactory, because the belts make the light unsteady, and, therefore, unfit for the purposes designed. Some time ago the Southwark Company, which manufactures a high-pressure engine—the Porter-Allen—received an order from Mr. Edison to manufacture an engine that would make 600 revolutions per minute. This is to be of 100 horse-power, and, if it proves successful, then the great trouble which has encompassed the Edison light will be overcome. Recently, and before the first engine was well under way, another order was received for a 120 horse-power engine. The highest number of revolutions heretofore attained by any one of the Porter-Allen engines has been 500 revolutions per minute. The result of the experiment will be waited for anxiously by engine-builders all over the country, and should Philadelphia mechanics provide just the thing needful there will be a big "boom" in Southwark to supply the demand.

Underground Cable for Vienna.—MM. Rattier et Cie., of Paris, have supplied for the underground system of telegraphs in Vienna a large quantity of insulated conductor in the form of a strand, composed of seven wires, six-tenths of a millimetre in diameter; the strand being coated with gutta percha to a thickness of 5 mm., and having an outer covering of tarred cotton. Seven of these strands constitute a cable, which is protected by tapes of tarred cloth, by a second covering of tarred hemp, previously saturated with sulphate of copper, and, lastly, by a tape of tarred woollen fabric. The specific conductivity of the wire is 98 per cent. of that of pure copper; the insulation resistance varies from 1,100 to 3,000 megohms per kilometre; and the inductive capacity is from ·21 to ·25 microfarads per kilometre. The tar which is employed is almost completely freed from acids; but the hemp was found to be slightly acid by reason of its passage through the bath of sulphate of copper. The cable is manufactured in lengths of 500 metres, and is laid at a depth of 1·3 metre, in troughs made of red larch. Several cables are deposited together in a mixture of one part of cement to two parts of sand. In traversing the Franzensketten bridge, the wires, in order to avoid vibration, are not stretched, but are merely laid in the trough on a bed of sifted coal cinders. The containing troughs are made in lengths of from 3 to 5 metres. This cable, containing seven distinct conductors, costs about 2,800fr. per kilometre; and the total cost of manufacturing and laying 4,202 metres of underground line, corresponding to 33,431 metres of conducting wire, was about 137,000fr.

A Contemporary on the Electric Light.—A contemporary devoted to gas interests thus speaks of the prospects of the electric light at Liverpool:—"The Corporation of Liverpool are in no great hurry to make full use of the power they have acquired to use the electric light, and their delay has not passed unnoticed by the local press. It appears that the Picton Reading Room is the only public edifice yet lighted up in this way, and there are no signs of any further application of the new luminant to any of the bustling open spaces or markets of the city. We do not pretend to be sufficiently deep in the counsels of the Corporation to know why this is so, but we may perhaps form a guess which, in default of better information, may not be altogether wide of the mark. The application to Parliament was so recently made, that the idea of the city authorities having cooled in their ardour for more light cannot be entertained, without implication of a degree of fickleness on their part which would be monstrous. Perhaps the city council having had time to reflect on the precise value of the powers they acquired at such cost, have begun to see that the restriction under which they must supply the light—simply at prime cost without a penny profit—is such as to make them hesitate to incur an extended responsibility without the ability to derive pecuniary benefit from it. Unlike the business of supplying gas, which corporations did not seek to enter into until the absolute safety of the capital involved had been proved by long experience, the establishment of any system of lighting by electricity for general purposes still deserves to be classed as an experiment, in the sense that of several rival methods of producing and utilising the light there is not one but possesses some damaging qualification which the advocates of the others are always ready to point out; so that the position of a gas committee badgered by local partisans of electricity, although troublous enough at times, is serenity itself compared to that of an electric lighting committee committed, say, to the Jablochkoff system, with an active opposition favouring the Jamin light. We do not know if the demand for more electricity is supported by the public; but, in any case, whether the Liverpool authorities act up to their powers or not, we may safely predict that they will have a lively time of it in the council chamber and among the ratepayers outside."

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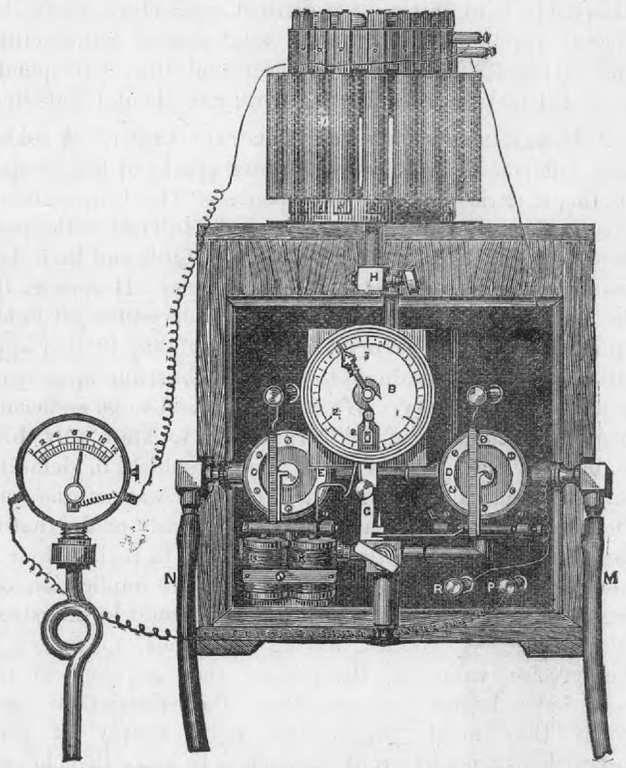
ELECTRIC TEMPERATURE REGULATOR.

There are numerous chemical and other processes which require a continued maintenance of an equable temperature. A familiar illustration of this is the equable temperature required by manufacturing dentists in vulcanising the caoutchouc palates for false teeth. For this it is necessary that the pressure, which is proportional to the temperature, should sometimes be the same for several hours, and this cannot be accurately maintained, except by simply watching the pressure gauge attached to the digestor or closed vessel in which the caoutchouc is placed. This watching occupies so much time that, except where assistants can be deputed specially to the work, it is often but indifferently performed, and though the vulcanite is rendered inferior for the purpose if subjected to great range of temperature it is nevertheless used. For this purpose, then, in particular, an automatic temperature regulator is essential, and such an apparatus has been invented and patented in this country by Mr. Joseph Davidson of Berlin, who is represented in this country by Mr. H. Pischon, Metropolitan Chambers, New Broad-street. The principle of the apparatus consists in the control of the gas flame, by which the closed vessel is heated, by means of an electro-magnet, which is put in or out of action by a pressure gauge, when the pressure is above or below the desired limit. For this purpose the gas supply pipe has a valve which is connected to the



armature of an electro-magnet, so that when the latter is in action it holds the valve open against the action of a spring which tends to close the valve. One terminal of the coil of the electro-magnet is connected to the ordinary pointer of a pressure gauge, which communicates with the interior of the vulcanising vessel. The other terminal is connected to a second pointer, which is kept in electrical contact with the first pointer by the action of a spring until this moves beyond the point at which it indicates the maximum pressure, at which point is a stop adjusted by a knob outside the pressure gauge glass, and arranged so that it prevents the second pointer from following the first beyond that point. The two pointers being thus separated, the circuit is interrupted, thereby stopping the action of the magnet, which thus allows the valve to close. When this is effected, a by-pass with regulating cock allows sufficient gas to pass to the burner to prevent it from being entirely extinguished. On the pressure being reduced the first pointer of the gauge in receding comes in contact with the second one again, thus re-establishing the electric circuit, and effecting the opening of the supply valve. Within the range of about one degree the temperature is constantly maintained. The gas supply has a second shut off valve, which is kept open against the action of a spring by a detent connected to a clock, and so arranged that when the clock has been in motion for a determined length of time, the detent is released, and allows the valve to close and cut off the gas supply entirely, thus terminating the vulcanising operation. In order that it should not be even necessary for the operator to wait until the necessary is first attained, an arrangement is made by which the regulator sets itself to work when that pressure is reached, and it then, from that moment, regulates the pressure for any duration of time for which the clock may be set. The armature of the magnet is provided with an arm that withholds the pendulum of the clock until, by the attainment of the full pressure, the action of the electro-magnet is temporarily interrupted for the first time. The armature is then raised by the spring connected to it, the pendulum released, and the clock starts, continuing for the determined duration of the process of vulcanising, at the expiration of which the clock detent allows the other spring to close the valve which it controls, and thus all gas is shut off.

The apparatus is all enclosed in a box, the glass door of which is removed in our sketch, which shows the box in section. The electric current is provided by a Noë thermo-electric battery on the top of the box, with twenty elements, and heated by a Bunsen burner, supplied by the pipe, fitted with a cock, H. This battery, which is much used in Germany and Austria, was described in detail in *The Electrician* of the 8th May last. In the illustration B is the clock referred to, C the valve through which gas passes by the pipe N to the vulcanising vesssel, M the pipe supplying the gas to the apparatus, KK the magnet, F the armature, and E the arm which holds the clock pendulum until the current is first broken. G is the clock detent which rises into the notch in the disc on the clock spindle when the determined period has passed, and thus permits the spring to close the valve D and shut off all gas. The terminals are connected with the gauge and battery, as shown, and to the magnet, by means of the binding screws R and P, connected to wires behind the wood base on which the whole is mounted. The pressure gauge is shown unattached to the vulcanising vessel, and as shown the adjustable stop of the gauge is set to prevent the rise of pressure above $6\frac{3}{4}$ atmospheres.

Though described as employed for a special purpose the apparatus is obviously applicable as a thermo-regulator for many purposes.

In the new air thermometer of Herr Witz there is another very ingenious electrical arrangement for keeping one of the air bulbs of the apparatus at a constant temperature so as to serve for a standard and make the readings give absolute (not differential) results.

The object was to find a means of keeping the air inside the standard bulb at a practically constant temperature, and Herr Witz achieved it in the following manner. A very fine platinum wire was rolled in a helix, and introduced into the interior . It makes part of an electric circuit, which is closed by a mercurial column, movable in the recurved part of an alcohol thermometer, similar to that of Lix and Bellani. The movement of the alcohol and mercury in this auxiliary thermometer depends on the temperature of the air in the interior of the bulb where the platinum wire is fixed. One end of the mercury column is always in contact with the platinum wire; the other, on the contrary, opens or closes the circuit of a battery in advancing or receding. At the moment when the temperature of the air in the bulb decreases below a determined point the circuit closes, the current passes through the platinum wire, which is heated, then the temperature rises in the bulb, the mercury again opens the circuit, and the current is interrupted. The fixed temperature of the standard bulb is ten degrees C. higher than that of the surrounding air, and there is, therefore, a continual tendency for the hotter bulb to cool down. The result is that there is an oscillation of temperature in the standard bulb, as it is replenished with heat by the current, and parts with some of it again; but the range does not amount to more than $\frac{1}{10}$ degree C. With a steady battery the apparatus works well.

The best battery for the purpose yet tried by Herr Witz is that of Poggendorff, recently described in these columns. It is a bichromate of potash battery, as our readers will, perhaps, remember, and has an electromotive force, quantity and constancy well adapted to the regulating purpose in question. By taking care to renew every day a little of the acidulated water rendered greenish by sulphate of chromium, and to add a crystal of bichromate of potash into the porous vase, two small cells maintain the thermal regulator at 29·5° C. during a long time. Perhaps this device of Herr Witz will prove useful in other ways.

NEW BATTERIES.

The action of batteries and the conditions governing it are so little studied that the following results of M. d'Arsonval are very welcome. According to that *savant*, the chemical action in

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batteries with two liquids when the circuit is opened is never entirely stopped. This effect pertains to cells in which the liquids diffuse into each other across the walls of a porous chamber, or by direct contact without porous separators, as in the Calland cell.

To remove this defect M. d'Arsonval has devised the two following plans, which, he says, succeed very well:—

The first means is founded on the absorbant properties of animal charcoal, and is applied to all batteries wherein the liquid depolariser is a metallic salt. If a solution of a metallic salt (copper, lead, mercury, &c.) be filtered through washed animal charcoal, the salt is retained by the charcoal, and we get pure water. In certain cases the metallic salt is decomposed; for example, in the case of metallic acetates free acetic acid drains away.

Setting out from this observed fact, M. d'Arsonval has constructed a sulphate of copper battery, in which the cuprous solution cannot diffuse itself over the zinc. For this purpose he takes an ordinary Calland element, at the bottom of which he deposits a layer of pulverised sulphate of copper, covered with clean animal charcoal in powder. The zinc is placed at the upper part of the vessel, and is, consequently, separated from the sulphate of copper by a layer of animal charcoal. The voltaic element thus constituted resembles a Minotto cell, in which the sand has been replaced by animal charcoal.

In these circumstances the zinc remains completely unaltered. For over three years already M. Gaiffe has employed this cell of M. d'Arsonval's without experiencing the least change in its power.

The only inconvenience of this form is the increase of internal resistance which springs from the presence of the animal charcoal, an inconvenience that sand also brings with it, without the corresponding advantages. M. d'Arsonval has tried, with M. Gaiffe, to manufacture porous vessels of agglomerated animal charcoal, but hitherto he has not succeeded. M. Carré, who at M. d'Arsonval's request undertook to try, was not more successful. But, even as it is, this form of cell is very serviceable for producing constant currents.

The second method followed by M. d'Arsonval for getting rid of waste action in batteries is of much more general application than the first, and consists in taking as a depolarising body a liquid which gives a precipitate by its mixture with the liquid attacking the zinc. The diaphragm separating the two liquids is in this way rendered impermeable. The precipitate formed in the pores of the vessel ought to satisfy two conditions: 1st, it ought to be a conductor of electricity, and 2nd, it ought to be electrolysable.

The combinations satisfying these conditions are exceedingly numerous. M. d'Arsonval recognises at least twenty, the chief of which are—

I. *Precipitate formed by the mixture of two salts. Nitrate of silver battery.*

This battery is constituted in the following manner. In the exterior vessel there is a zinc plate and chloride of zinc solution; in the porous chamber there is a solution nitrate of silver and a silver plate. These two liquids can mix, and thereby give rise to a precipitate of chloride of silver, which fills up the pores of the porous vessel and renders it impermeable. This precipitate conducts electricity very well, and is moreover electrolysable. Such a battery has very little resistance; its electromotive force is equal to 1·5 volts, whilst the same pair with chloride of silver only gave 0·9 volts. The high price of silver salt renders the battery only applicable under particular circumstances, as in medical electricity or the charging of electrometers, and, M. d'Arsonval might have added, in cable testing.

A more practical combination is the following. Zinc sulphate solution surrounding a zinc plate, and nitrate of lead surrounding a lead plate. The electromotive force is, however, very feeble, being 0·6 volts to 0·75 volts.

II. *Precipitate formed by the mixture of a base and a metallic salt.*

In this case the zinc is attacked by a base, potash, soda, or ammonia. M d'Arsonval has tried the following combinations:—

First—Soda and sulphate of copper, which gives an electromotive force of about 1·5 volts.

Second—Soda and perchloride of iron, which gives about 2·4 volts.

Couples with potash have an enormous resistance, probably because the carbonate of potash, formed by the air, disengages its carbonic acid in contact with sulphate of copper, and the gas bubbles collect in the pores of the diaphragm, and destroy its conductivity. The solution of potash can, however, be made more conductive by the addition of sea salt or of sulphate of soda.

THE ALTERNATING ELECTRIC DISCHARGE.

The alternating discharge apparatus devised by M. Thenard is well adapted to show the shower of electric fire in different gases under various pressures, for the phosphorescent lights, invisible in full day, which illumine the gas placed in the annular space comprised between the two tubes of concentric gas, when analysed with care in the obscurity, always exhibit the character of a shower.

If the phenomenon is very difficult to observe in oxygen, it is, on the contrary, found by MM. Hauteville and Chappuis to be very easily recognised in fluoride of calcium.

When produced at atmospheric pressure in this substance, the spark has the appearance of a homogeneous luminous sheet. The annular space is filled with little luminous globules of a greenish yellow hue in darkness, and a tender rose colour in diffused light, the flame of a candle. In examining the tube by a magnifying glass during discharge, we are struck with the analogy which the phenomenon presents with that described by MM. de Mondesir and Schlœsing in their beautiful experiments on "electric butterflies," where the burning of hydrogen in the air gives lights which move like swarms of flies.

The discharge in fluoride of silicon is easiest of all to study if the distances of the electrified surfaces attain several millimetres, because the luminous points, well separated, show that the successive discharges take place under the form of little luminous cylinders joined to small phosphorescent sheets with circular outlines; so that if the two cylinders are concentric, the central tube seems to be plastered on its exterior surface with regular luminous lines, equidistant, and terminated at the other tube, the whole recalling a mop with luminous tags. If the two cylinders are not concentric, the discharge only passes between the nearest walls, allowing the phenomenon to be studied on the edges. The space seems traversed by a shower of fire, as in the apparatus of M. du Moncel.

A diminution of pressure of the fluoride of silicon does not change the general characters of the discharge; but, in withdrawing the tubes of electrified glass, it can be readily proved that each luminous line is swollen at the ends. With low pressures the luminous drops, instead of designing themselves on a black background, seem hid in a violet mist. At the same time their contours loose their definition. A maximum of splendour is seen in the discharges which occur in the plane passing through the observer and the axis of the apparatus. The cylindrical lines, if dilated in rarefied gases, preserve, nevertheless, a lively splendour when the eye looks along them.

For pressures below ·005 mètres the general illumination masks the shower of fire almost completely—the drops seem to be deep in the mist.

Nitrogen is, after fluoride of silicion, the gas which gives the finest rain of fire. At ordinary pressure the globules—of a pale reddish blue—are very small and very close. The phenomenon takes more splendour of colour when we reduce the pressure of nitrogen to what supports the gas in air. We only obtain a luminous sheet of homogeneous appearance at pressures below 0·050 mètres.

Hydrogen exhibits also this form of discharge. At atmospheric pressure the phenomenon in colour is almost identical with what we observe in fluoride of silicon at low pressures.

The same appearances are observable with chlorine. The luminous drops are greenish, and much less brilliant than those of fluoride of silicon. This gas, under ordinary pressure, opposes a very great resistance to the passage of electricity. The electrified surfaces ought to be very near, for if they are at 0·002 mètres, for example, the luminous lines, without having the character of a spark, resemble it in luminous intensity. This mode of discharge is distinguished from the preceding by the small number of luminous lines and the brilliant *aigrettes* which appear on the surface of the walls of the tube, uniting amongst them the successive lines situated sometimes more than a centimetre from each other.

In oxygen the discharge is hardly visible, the gas becomes very slightly luminous, or rather phosphorescent. Nevertheless, in darkness, and by the aid of a magnifying glass, a granulation on the surface of the concentric tubes can be noticed, and, if the gas has not too feeble a tension, the distinct luminous globules can be detected.

The constitution of the milky white lights produced by the alternating discharge in carbonic acid recalls the lights observed in oxygen, but the analysis of them is easier.

These discharges are only silent, in all gases, at feeble pressures. They are silent also in hydrogen at atmospheric pressure. The rain of fire is accompanied in other gases by a rustling sound.

Discharge tubes, such as are constructed by M. Alvergniat, will show the rain of fire under its various aspects in different gases under different pressures.

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THE BRITISH ASSOCIATION AT SWANSEA.

The remark is often made that the British Association meetings are not so good now as they were in olden days, that many men who have earned a scientific reputation do not favour the meetings either with their presence or with papers. There is something in such statements which may be true, just as there are two sides from which every question may be viewed. Those who speak loudest against these meetings are generally such as, for some reason or other best known to themselves, do not attend the meetings, and so have only hearsay evidence to guide them in forming opinions. We are bound to maintain that neither the newspaper reports, nor the report of the Association itself, valuable as are these publications, give adequate ideas as to the value of such meetings. The value is not altogether from papers read and discussed, but we opine the greater value is to be attached to the bringing together man with man in social intercourse, if only for a week. The younger members must, if they possess any intellect at all, gain from even a short contact with maturer minds. Men who have pet hobbies and moot their ideas, giving startling conclusions, are met with cool logic which points out this difficulty and that difficulty in quite a new light. They are taught to be cautious, to be sure of new results before bringing them before the world. They find a sprinkling of true scientific thought before which "filthy lucre" is as nought; they meet men who, if their lives had been devoted to business as earnestly as they have to scientific investigation, would long ago have obtained a fair share of wealth, but who probably from year to year have gone on working at new inspirations, barely enabled at the close of each year to make both ends meet.

If at times the meetings have seemed to be wholly in the hands, and worked by a clique, it has been the fault of those who hold aloof. No clique, however powerful or persevering, could wield the power of an association if every scientific man of any repute recognised that he had a duty as well as a privilege. It is, perhaps, the duty of the younger men to seek the elder, but if the elder steadfastly keep away from the younger how can he obtain his desire? The duties of life keep men of science apart during the greater portion of the year, and it is only by such meetings as that of the British Association that a broad common platform can be found. There men from every point of the compass can safely go, knowing that they will meet brother labourers—will hear of similar hopes, fears, and successes as they have encountered during the year of separation.

It is not to be expected that much work of a startling character will nowadays be brought before the sections. The Press is too powerful, the facilities it gives too useful to allow of waiting to a set date before investigations are made public. Then, too, it must be remembered that on every hand minor societies with special objects during the long winter season lay hands on their members, and use every endeavour to influence those capable to give good papers. In years gone by many papers read during the late session of the scientific societies would have remained for the British Association. Applied science, again, is daily becoming more and more in earnest. It calls for the original investigations to be made public at the earliest possible moment, so that any new laws or new results may be turned to the use of the world at large. No doubt the monetary influence is here predominent, but the fact nevertheless remains, and in discussing the value of papers read at annual meetings of the British Association must be remembered.

The Association meets this year at Swansea for its fiftieth annual meeting on the 25th inst., under the presidency of Professor A. G. Ramsay, F.R.S., V.P.G.S., Director-General of the Geological Survey of the United Kingdom and of the Museum of Practical Geology. We do not know how the presidents of the British Association are selected, whether special studies are taken into account in proposing presidents for meetings, but hardly could a selection have been better than that which gives the president's chair to a distinguished geologist at a meeting which takes place in one of the most interesting districts, geologically considered, in the kingdom. The Presidents of the Sections are—Mathematical and Physical, Professor W. G. Adams, F.R.S.; Chemical, Mr. J. H. Gilbert, F.R.S.; Geological, Dr. H. C. Sorby, F.R.S.; Biological, Mr. A. C. Gunther, M.A.; Geographical, Lieut.-General Sir J. H. Lefroy; Economic, Mr. G. W. Hastings, M.P.; Mechanical, Mr. J. Abernethy, V.P. Inst. C.E., F.R.S.E. A number of popular lectures have been arranged, none of which, however, deal with electrical subjects.

We may again take the opportunity of calling attention to an innovation which has been carried out with regard to the report of the Association during the last two years. Authors are requested to supply abstracts, so that the report may be issued at an early date after the meeting. Such issue increases the value of the report, and it is to be hoped the energetic secretary will again find authors agreeing with him, so that the work he has so much at heart may be facilitated.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

LECTURE I.—DELIVERED FEBRUARY 2, 1880.

Sources of India rubber—Chemical and Physical Properties—Behaviour with Chemical Re-agents—Action of various Solvents—Effects of Heat, Cold, and Light.

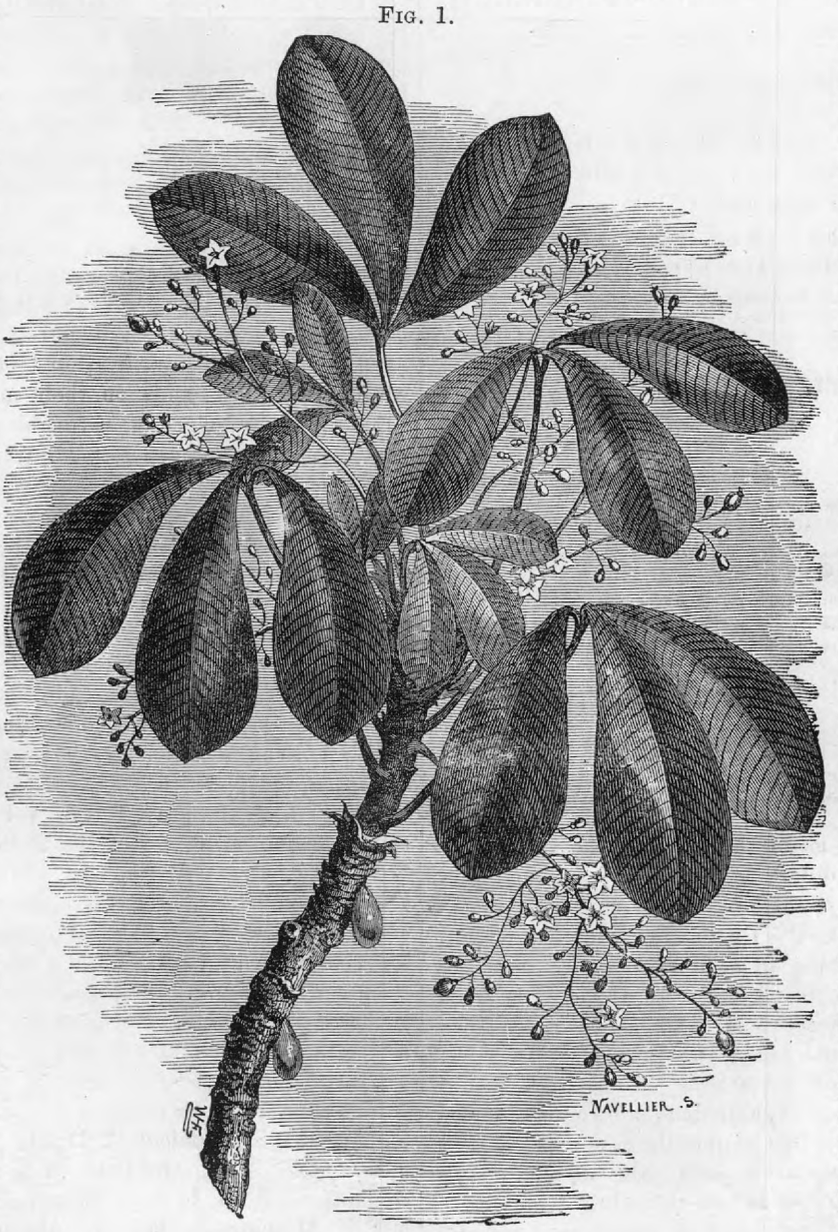
India rubber or caoutchouc possesses properties so widely different from those of most other substances, that it became an object of very great interest as soon as it made its appearance in the civilised world, and its industrial importance has rapidly increased as the knowledge of its remarkable characters and manifold applicability has become more extended. At the present time, caoutchouc holds such an important position with to regard the economy of modern arts and manufactures, that were it suddenly to be withdrawn from circulation, many minor industries would in consequence cease to exist; while numerous large and important branches of handicraft would languish until arrangements could be made to adapt their operations to the altered circumstances.

It is, however, during the last forty years that india rubber has enjoyed its greatest triumphs as an industrial agent; that is to say, since the art of vulcanisation was discovered and perfected by the labours of Charles Goodyear, Thomas Hancock, and others.

The earliest rumour of the existence of caoutchouc reached Europe nearly 500 years ago; the first visit of Columbus to Hayti having brought to light the fact that the natives of this island were in the habit of making playing balls of an elastic gum. Nothing more appears to have been heard of india rubber until Torquemada, rather over 250 years ago, described the Mexican Indians as not only making playing balls of india rubber, but also as fabricating helmets, shoes, waterproof fabrics and other articles of elastic gum. This writer gives some details as to the collection of the juice and the making of various articles from it, thus giving us the first view of the india rubber manufacture as a branch of industry. We do not hear, however, of samples of india rubber reaching Europe until long after this, and little more appears to have been learned regarding the substance until the celebrated French naturalist, La Condamine, made a communication to the Academy of Sciences at Paris concerning caoutchouc, he having had ample opportunities of studying the subject in Para. In the memoir in question La Condamine gives very detailed particulars regarding the Para india rubber tree, the collection and treatment of the juice, and the methods made use of by the natives for the production of various articles of caoutchouc. He tells us that the substance in question was used for making torches, these being only an inch and a half in diameter by two feet long, and yet burning for 12 hours. Again, we hear of the use of india rubber for the making of playing balls, and it appears that the natives were in the habit of using enema or injection bottles made of caoutchouc.

Soon after La Condamine's communication to the Academy of Sciences samples of india rubber frequently reached Europe, and scientific men began to make investigations regarding this remarkable body. Between 1760 and 1770 we find Fresneau and Macquer studying the subject, and the last-named investigator made tubes and other articles of caoutchouc by dissolving it in ether and coating moulds with the solution, so that a solid skin of caoutchouc should remain adherent to the mould on the evaporation of the solvent.

FIG. 1.



HEVEA GUIANENSIS.

From this time until the end of the eighteenth century the india rubber industry may be considered to have been undergoing its period of gestation, and to have been born with the dawn of the present century. Among the first of the important patents regarding the utilisation of caoutchouc, is that granted in 1823 to Charles Macintosh, for dissolving the substance in coal oil, or coal naphtha, and the use of this solution as a waterproofing agent. I have here a specimen of such a solution, as now manufactured by Messrs. C. Macintosh and Co., of Manchester, together with some examples illustrating its uses.

About the same time elastic webbing was first made with threads, cut from the raw rubber, and other minor applications of caoutchouc to the industrial arts were adopted from time to time, until the great discovery of vulcanisation inaugurated a new epoch in this branch of industry; rendering it possible to so far alter caoutchouc as to make it capable of resisting to a great extent the action of heat on the one hand and cold on the other hand.

The milky sap of many plants contains caoutchouc, suspended in the form of minute transparent globules, these being frequently as small as $\frac{1}{20000}$ to $\frac{1}{50000}$ of an inch in diameter; but comparatively few plants contain sufficient caoutchouc to render them important sources of this body. The trees which yield the largest supply of the best quality of caoutchouc, consist of various species of hevea, which flourish in the the northern districts of South America, especially in the province of Para, some portions of the valley of the Amazon being crowded to an extraordinary extent with heveas. The abundance of the india rubber trees in Para may be judged of by the fact that this province alone exported 7,340 tons of caoutchouc in the year 1877; more than half of this being sent to Liverpool.

Among the heveas most productive of caoutchouc may be mentioned the *Hevea brasiliensis*, which flourishes in Para, and yields some of the finest caoutchouc, and often attains a height of 60 to 70 feet, with a diameter of nearly three feet; the *Hevea*

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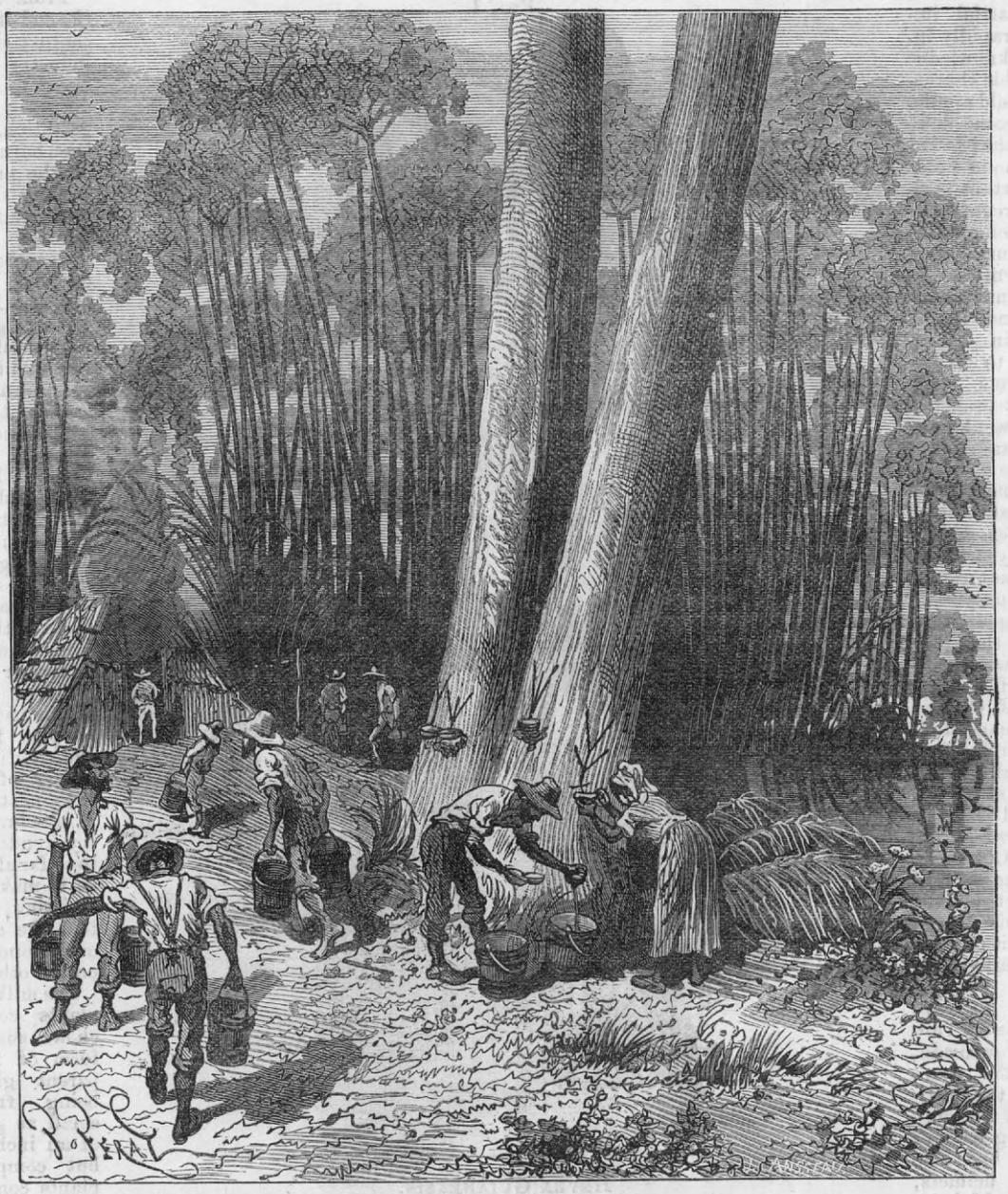
guianensis, a similarly magnificent tree, likewise abundantly productive of caoutchouc and the *Hevea spruceana*, a smaller tree, which grows almost exclusively in the province of Para.

I now project on the screen a lantern slide representing a forest of heveas, and next I will show you one which will give you some idea of the foliage and flower of the *Hevea guianensis*. (Fig. 1.)*

The operation of collecting the juice is well illustrated by the drawing (Fig. 2) which is now projected on the screen. A A series of cuts being made through the bark of the tree, either shells or clay vessels are attached to receive the exuding milky sap; and when sufficient of this has been collected, the operation of drying it is performed as follows:—A kind of wooden bat, thinly covered over with clay, is dipped into a pail filled with the juice, and the bat, thus coated, is held over a fire, fed with certain wild nuts, which, in burning, give off abundance of aromatic smoke. The picture now on the screen (Fig. 3†) represents this operation, and you will see that a kind of short chimney is fixed over the fire to lead the smoke compactly upwards. As soon as the first layer of juice has become indurated, the bat is again dipped, and the drying operation is repeated; layer after layer being thus dried on the bat, until a thickness of nearly an inch is attained. A knife cut is now made in the bottle or biscuit of caoutchouc thus obtained, so that it can be removed from the wooden bat, and exposed to the air to become still further indurated. Para caoutchouc, prepared in this manner, has a fragrant aromatic odour, which you can study for yourselves in the samples now before you.

The residues of juice left in the various vessels employed, the scrapings of the incisions, together with other materials, which the ingenious native thinks he can shuffle off on the unsuspecting merchant as caoutchouc, are made into balls, and sold as "negro head." The negro head rubber is frequently made into crude representations of animals, and there are several such works of native art on the table—as, for example, this specimen, which will pass about equally well for a horse, a pig, or a crocodile. For the opportunity of showing you this very fine collection of specimens of raw rubber, I have to thank the Silvertown

FIG. 2.



COLLECTION OF THE JUICE OF THE INDIA RUBBER TREE IN PARA.

Company, Messrs. Tuck, Messrs. Macintosh and Co., and others. Your attention will be specially called to some of these shortly.

Here is a piece of Para bottle-rubber, which has been boiled for some hours in water, and you see that it is now so far softened as to render it easy to pull asunder the several layers of which it is composed, its laminated structure being thus very well illustrated.

The milky juice of the Para rubber trees, of which you see a specimen before you, has approximately the following composition:

Caoutchouc	32
Albumenous, extractive, and saline matters	12
Water	56
	100

* This engraving, and also some of the other blocks used to illustrate these lectures, are taken from Figuier's "Merveilles de l'Industrie," permission for their use having been granted by the publishers, Messrs. Furne, Jouvet, and Co.

† Figs. 3 and 4 will be given in our next issue.

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As a rubber-producing tree, the *Ficus elastica* stands next in importance of the heveas. The *Ficus elastica* grows abundantly in India and the East Indian Islands, one district in Assam, thirty miles long by eight miles wide, being said to contain 43,000 trees, many of them attaining a height of a hundred feet. This tree also grows freely in Madagascar, and it is well known to us as a greenhouse plant. The slide now projected on the screen represents the *Ficus elastica* in its native regions; and I will next show you one illustrating a *Ficus elastica* now growing out of doors in the Parc Monceau at Paris. (Fig. 4.)

The juice of the *Ficus elastica* contains notably less caoutchouc than that of the American trees, the proportion very often falling as low as 10 per cent. of the juice.

A vine-like plant, the *Urcola elastica*, which grows abundantly in Madagascar, Borneo, Singapore, Sumatra, Penang, and other places, yields a considerable amount of caoutchouc of very good quality, and you will find specimens of the substance from these districts on the table.

Africa yields a considerable quantity of caoutchouc, but generally soft and of inferior quality. It is believed to be yielded by various species of landolphia, ficus, and toxicophlea. Here are some specimens of African rubber. This specimen, representing the quality known as African ball, being tolerably firm in consistency, while the African flake, which you see here, and the African tongue represent the lowest and most viscous qualities of commercial rubber. In order that you may compare the two extremes of quality, I will hand round a specimen of fine Para together with a piece of African tongue.

The commercial value of the various qualities of rubber may be estimated, to a certain extent, by noting the loss which the samples undergo during the operation of washing, which operation will be described in the next lecture; and also by noticing how far the various samples are softened by a long continued gentle heat. Here are some samples which have been heated for some hours in this water oven; you will notice that the African tongue has become almost as soft as treacle, while the Para rubber still retains its form, and much of its consistency. The purification of caoutchouc will be considered next week, but your attention will now be called to the properties of pure caoutchouc.

Caoutchouc is nearly colourless, and when in thin leaves tolerably transparent. It, like very many other substances, contains nothing but carbon and hydrogen, but its properties differ very widely from those of other hydro-carbons almost identical in composition. It has been found to contain, in one hundred parts, 12·5 of hydrogen and 87·5 of carbon. Caoutchouc, as might be supposed, burns very readily and leaves no residue: if I set fire to a few ounces, you see how it blazes up. It is soft, and very imperfectly elastic, in the true sense of the term; that is to say, it does not return to its old dimensions after having been considerably stretched. Here is a strip of pure (*i.e.*, unvulcanised) caoutchouc a foot long; you see that I have stretched it to a length of three feet, and, after holding it stretched for a few seconds, I relax it. It now measures, as you see, several inches over the foot. The elasticity of caoutchouc may be enormously increased by vulcanisation, as I will illustrate to you in future lectures.

(TO BE CONTINUED.)

STUDENTS' COLUMNS.

VELOCITY OF ELECTRICITY.

A correspondent, dating his letter from Marseilles, writes to request "a lucid answer with reference to the ratio between the speed of electricity and that of light." As it is probable that a statement in "Answers to Correspondents" to the effect that no such ratio exists, or, at least, that it is impossible to determine it, might be considered insufficiently lucid, we purpose devoting a little space under this heading to the explanation of the fact as here stated. Many young electricians, besides our correspondent, appear to be under the impression that electricity travels with an assignable and constant velocity, such as that of 288,000 miles per second, which was the speed observed by Professor Wheatstone in his celebrated experiments at King's College, from which, unfortunately, some very erroneous conclusions were deduced; and it cannot be too widely made known that, as Mr. Fleeming Jenkin observes, "the same quantity of electricity may, under different circumstances, be made to traverse the same distance with almost infinitely differently velocities," and that, in fact, there is no velocity proper or peculiar to electricity. And in these days it should be understood, also, that the results obtained in Wheatstone's experiments were not "conclusively in favour of the double fluid hypothesis as to the nature of electricity," and that they are equally compatible with the single fluid, or, indeed, with any other hypothesis that has yet been advanced in this relation.

The destinction to be made between the *velocity of electricity* and the *velocity with which a given quantity of electricity can be transmitted* requires, in the first place, to be insisted upon in order to arrive at a logical conception of the real questions involved. Now, it may at once be stated that what is meant by the term "velocity of electricity" has never yet been defined, and that the velocity with which a given quantity of electricity can be transmitted varies "directly as the inductive resistance and inversely as the conductive resistance of the circuit through which the transmission takes place."* Thus, taking, as is usual, inductive capacity (F) in farads, instead of its reciprocal "inductive resistance," the *time* (*t*) in which a condenser, when circuited, will lose any given fraction of its charge is

$$t = \mathrm{R}\cdot\mathrm{F}\cdot k \text{ seconds};$$

R being here the resistance in ohms,† and k a constant which depends only upon the ratio between the final and initial charges. Quoting from the same authority: "if this ratio equal ·367, k is unity, and, if it equal $\frac{1}{2}$, k is ·693." Therefore any condenser will lose 633 thousandths of its charge in R F seconds, and any condenser will fall to half charge in R·F· × ·693 seconds. And although an experiment with an ordinary condenser represents a simplified case, whereas an experiment with an elongated condenser such as a submarine cable presents conditions of greater complexity, it is to be observed that all cases of electrical transmission necessarily involve a conductor or electrical resistance and inductive capacity or a condenser. Since velocity is measured by the length of the conductor divided by the time, it will be seen that data may be obtained for calculating the speed at which a given quantity of electricity may be transmitted under any given conditions. And if we adopt the convenient plan of measuring velocity by the product of the length of wire (L) in knots into the number of elementary signals that can be transmitted per second, the "given quantity of electricity" being here that which will produce a signal on the instrument employed, then, according to the data given by Messrs. Clark and Sabine,‡ the velocity of transmission, with the mirror instrument, would be

$$\mathrm{V} = \frac{43{\cdot}3 \times \mathrm{L}}{\mathrm{R\,F}};$$

the product RF being, as before, either ohms into farads or megohms into microfarads.

Prior to the year 1834, it was held that the "velocity of electricity" was so great as not, under any circumstances, to be measurable. And the first result of Wheatstone's experiments was to show that the duration of the discharge from a Leyden jar, when the latter was "short-circuited," was not so much as the millionth part of a second. In these experiments the image of an electric spark was received upon a mirror in rapid rotation; one spark passing at each rotation, when the mirror was in a position to render it conveniently visible. With a high velocity, the image of a spark having any measurable duration would appear elongated; the length becoming greater as the velocity was increased. Now, with the short-circuited jar no enlongation in the image of the spark could be perceived; but when the jar was discharged through a copper wire half a mile in length the elongation became very appreciable. This result was sufficient to show that the propagation of electricity is not instantaneous; other arrangements, referred to as follows in Nord's "Student's Text Book of Electricity," had to be made in order to determine the velocity of transmission. "A jar was discharged through a copper wire half a mile in length, interrupted both in the middle and at the two extremities so as to give three distinct sparks. The deviation of half a degree between the two extreme sparks would indicate a velocity of 576,000 miles in a second. This estimated velocity is on the supposition that the electricity passes from one end of the wire to the other; if, however, according to the *two-fluid* theory, the two electricities travel simultaneously from the two ends of the wire, the two external sparks will keep their relative positions; the middle one alone being deflected, and the velocity measured will be only one-half that in the former case, viz: 288,000 miles in a second. The following were the results actually obtained:—In all cases when the velocity of the mirror exceeded a certain limit the three sparks were elongated into three parallel lines, and the lengths became greater as the velocity of the mirror was increased. The greatest elongation observed was about 24°, indicating a duration of about the 24,000th part of a second.

* D. G. FitzGerald: Lecture on "Speed of Signalling," given at the School of Telegraphy, George-street, Hanover-square.

† Or R may be megohms, if F be microfarads.

‡ "Electrical Tables and Formulæ," p. 75.

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When the velocity was low the terminating points appeared to be exactly in the same vertical line, but when the velocity was considerable, and the mirror revolved towards the right, the lines assumed the appearance ⟍, when it revolved towards the left they appeared ⟋; but in no case were they seen ⟍ or ⟋ as required by the hypothesis of a single-fluid."

The single-fluid hypothesis really requires nothing of the kind, nor indeed does it fail to account for any hitherto observed phenomenon less satisfactorily than the superfluously-complicated theory of Du Faye. According to the former view, one of the coatings of the jar, say the inside coating, has an excess of electricity, or is charged positively; whilst the outer coating is minus a portion of its normal charge, or is charged negatively. By induction, the extremities of the wire in proximity to these coatings obtain opposite electrical conditions, and sparks simultaneously pass from the inside coating to one of these extremities, and from the other of these extremities to the outer coating. And, subsequently, a spark passes across the central interruption in the wire, from that portion which is positively to that which is negatively charged. Owing to this simultaneous action the velocity of transmission would be the latter of the two values mentioned above, *i.e.*, 288,000 miles in a second.

It will be understood from what has been said that this value cannot be taken to represent the "velocity of electricity" but is merely that at which a certain quantity of electricity is transmitted under certain conditions. The student will not be surprised, therefore, that other experimenters have arrived at widely discordant results in determining the "velocity of electricity" through iron and copper wires. Some of these results are as follow:—

Observers.	Velocity in miles per second. Iron wires.	Copper wires.
Fizeau and Gounelle	62,600	112,680
Guillemin and Burnouf	—	112,680
O'Mitchell (America)	28,524	—
Walker	18,630	—
Gould	15,900	—
Astronomers of Greenwich and Brussels (London and Brussels telegraph)	—	2,700
Astronomers of Greenwich and Edinburgh (London and Edinburgh telegraph)	—	7,600

The student will also understand that there were definite grounds for the statement of Mr. Cromwell F. Varley that "a signal would be instantaneously transmitted through a wire extending from the earth to the moon."

It has been stated that, whilst a speed of 120 words, equal to about 2,400 elementary signals, per minute can be obtained by Wheatstone's system of automatic telegraphy, between London and Manchester, only 90 words can be obtained between London and Sunderland, 60 between London and Aberdeen, and 40 between London and Dublin.

The chapter on "Speed of Signalling" in Jenkin's "Electricity and Magnetism" should be carefully studied by all who desire an accurate acquaintance with the questions involved under this heading. It gives the substance of the theory in relation to signalling speed which was brought before the Royal Society by Sir W. Thomson in 1855. In reference to the (1866) Atlantic cable, Mr. Jenkin says:—"For about two-tenths of a second after contact is made in England no effect can be detected in Newfoundland even by the most delicate instrument: after ·4″ the received current is about 7 per cent. of the maximum permanent current which will ultimately flow through all parts of the circuit. The current will gradually increase until, 1″ after the first contact was made, the current will have reached about half its final strength, and after about 3″ it will have attained nearly its maximum strength; during the whole time the maximum current is flowing into the cable at the distant end. The 'velocity with which the current travels,' even in this one case, has therefore no definite meaning; the current does not arrive all at once like a bullet, but grows gradually from a minimum to a maximum. The time required for any given similar electrical operation on various lines is directly proportional to the capacity of the unit of length of the conductor, to the resistance per unit of length, and to the square of the length intervening between the sending and receiving stations."

In regard to the velocity of light, the expression has here a well defined meaning. If we suppose the light of the sun to be suddenly extinguished, the effect would not be perceptible on the earth until about 8¼ minutes after the event; and if, on the other hand, a luminary was suddenly to start into existence at a distance from the earth equal to that of the sun (91,600,000 miles), it would not be visible from the earth until after the expiration of the same space of time. The generally accepted value for the velocity of light is in fact 185,000 miles per second; and this implies simply that a luminous focus established at that distance from the earth would become visible to us in one second of time. No such definite significance attaches to the vague expression "velocity of electricity."

CORRESPONDENCE.

EARTH CURRENTS AND SUN SPOTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: One of the most interesting and, perhaps, difficult studies of the present time is that of recurring sun spots and their effect upon our globe. Considerable attention has been devoted to the phenomenon, but beyond the fact that sun spots exist, and a probability that they have their periods of maxima and minima, little is actually known concerning it. Theories have been started and conclusions jumped at in regard to various cosmical phenomena, which are said to have also periods of maxima and minima coinciding with the varying periods of sun spots—as, for instance, meteorological phenomena, magnetic and electric, not to mention famines, epidemics, railway accidents, and the price of Consols!

Although unable to express an opinion upon the effect of sun spots upon most of these, some remarks with regard to earth currents, with which I have enjoyed a more or less intimate acquaintance during the last fifteen years, may not be uninteresting. It has been suggested by some and accepted by others that in past years earth current forces of considerable magnitude have shown themselves during the periods of maximum sun spot periods, to again subside during the years of minimum spots, but so far as I am able to trace, we have as yet no sufficiently ascertained facts to settle the question. Nor does there appear to be extant the necessary data for arriving at anything decisive one way on another. Certainly at intervals all along the years 1864-5-6 and 7, and again in 1872 and '73, many earth current storms of greater or less magnitude came directly under my own notice, but in some instances the supposed earth current which appeared was proved to be a stray current from other lines, whilst in other instances the presumed earth currents were probably of human origin; nor will this be surprising to telegraph engineers of the earlier days when the then leaky state of the wires is remembered. There is another feature, however, not to be overlooked as regards earth current data for the past. To many the earth current had no existence until it became strong enough to deflect the comparatively heavy needles then in use, and only spasmodic records of such deflections have been the chief source of information and the basis of conjectural theory. The general result of the writer's nearly continuous observations over earth currents tends to warrant the presumption that sun spots do exert an influence upon the electrical state of our globe. There are striking coincidences between earth current variations upon the one hand, and magnetic variations, aurora, earthquakes, and sun spots on the other; but far more certain knowledge is needed before anything conclusive can be deduced, and these remarks may, perhaps, incite some, at least, to systematic observation.

In a paper read before the Society of Telegraph Engineers, I think I placed it beyond doubt that there existed a nearly constant line of maximum earth current—namely, about S.W. to N.E. As a rule this current is very weak, but my records show that occasionally, although at long intervals during the past five months, currents of unusual magnitude have prevailed, sufficiently exceptional, when taken in conjunction with the approaching maximum sun spot period, to be worthy of note. To-day, however, for the first time for several years, so far as I can find, an electrical storm of great magnitude has swept over the United Kingdom. The first intimation of the storm occurred at about 10:30 a.m., the current gradually increasing, at the same time constantly variable, until about noon, when the maximum appeared to be reached, equalling a force of 12 milli webers of current, a magnitude quite without precedent in my records of the past eight years. This storm appeared to follow pretty closely the normal maximum line, and may be interesting to some of your meteorological readers.

Should your valuable space permit, I hope soon to submit a short account of my past observations and the conclusions I individually draw from them.—Yours, &c.,

ALEXANDER J. S. ADAMS.

12th August, 1880.

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Stationed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore (by last advices).
Telegraph Construction	ss Calabria	3,321	220	A. Hyde	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	Lisbon.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Silvertown.
Telegraph Construction	ss Edinburgh	2,330	275	Seymour	East Greenwich.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Zanzibar.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	Killett	East Greenwich.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	ss Pouyier Quertier	1,385	160	Maypee	——
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Syra.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	Cato	Atlantic.
Telegraph Construction	ss Seine	3,579	500	Manning	Atlantic.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.

EARTH CURRENTS.

Several communications have appeared in our daily contemporaries, referring to auroræ, seen by various observers on August 12th. In "Slip" will be found those inserted in *The Times*. Connected possibly with this phenomenon we have accounts of strong earth currents on and about this date. A most interesting statement describing the earth currents on various cable lines, has been sent to us by Mr. H. Saunders, electrician in chief to the Eastern Telegraph Company. The phenomena of earth currents are so universal, so important to science, and so little understood, that we hope some way will be found to accumulate facts, from which data laws may possibly be deduced. Mr. Saunders, speaking of the electrical and magnetic disturbances of the 12th and 13th August says:—

"The earth currents on those days were exceptionally strong and variable, causing great interruption to the traffic over all the English and Continental lines, so much so that the Director of Telegraphs in France gave notice in the papers of the cause of delay to telegrams.

"I have collected the following data as to what was observed on the Eastern Telegraph Company's system and the Eastern and South African Company.

"Between London and Porthcurno, and London and Marseilles, and London and Liverpool, there were very considerable disturbances all day of the 12th, the maximum effects being observed between 11 a.m. and 4 p.m.

"The English Government and the Submarine Company's systems were also affected.

"The system upon which we work most of our lines, which is purposely intended to block earth-current disturbances, prevents them being noticed except when very strong and variable, so that on the cables from Porthcurno to Lisbon and Vigo nothing very unusual was observed; but upon a cable from Lisbon to Vigo, which is undergoing repair, and upon which an instrument is kept in circuit, strong and variable currents were observed on the 12th and 13th, the maximum being between 11 a.m. and noon, the weather being unusually calm and the sky thickly overcast.

"At Gibraltar very strong currents were observed on the cable to Lisbon at 10:45 a.m. of the 11th. On the 12th there were strong currents both on the Lisbon and Villa Real cable, maximum at 11:46 a.m., and currents on both cables during the 13th, but not so strong. Little or no current was noticed on the cable between Gibraltar and Malta on either of the days.

"Malta observed nothing unusual on the cables connected with Gibraltar, Marseilles, and Alexandria, nor did Alexandria observe anything on any of the cables connecting Malta, Cyprus, and Candia. In the Levant there was considerable disturbance on most of the lines. The Otranto Zante cable was violently disturbed between 10 a.m. and 4 p.m. of the 12th, and the Zante-Candia line the whole of the day, rendering working very difficult.

"On the 13th the former section was free, but the latter still slightly disturbed. Candia did not have anything unusual either on the Syra or Alexandria cables. The currents were also very strong upon the cables connecting Syra with Tenedos, and Pera and Tenedos and Salonica, as also on the Turkish lines, both on the 12th and 13th. The currents were not observed on the cable at Cyprus connected with Alexandria, but were on the land lines on both days, strongest on the 13th, and on the Larnaca Limassol section. Nothing exceptional was observed on the cables between Suez, Aden, and Bombay. But, curiously, currents appeared upon the Eastern and South African cables between Zanzibar, Mozambique, Delagoa Bay, and Natal. It is all the more curious that, as a rule, these lines are very free from earth currents.

"This is, of course, a very imperfect record, owing to the fact that cables are dividend-earning machines in the first place, so that when there is trouble on the lines the whole of the efforts of the staff are devoted to getting the traffic through, leaving little time for scientific investigation.

"However, the salient points are sufficiently determined, viz.:—

"1st. The extent of the disturbance extending over Europe, as far as Constantinople, down to the extreme points of the southern coast at Gibraltar and Otranto, but not affecting Malta or Egypt, nor the Red Sea; but turning up again at Zanzibar and along the east coast of Africa.

"2nd. The remarkable coincidence as to the time of maximum effect at different places widely separated.

"These dirturbances are generally accompanied by displays of the aurora borealis, and I see from a letter in *The Times* of the 14th that a vivid display was seen from Ilfracombe on the night of the 12th, extending over nearly 40° of the horizon beyond the Welsh coast. The aurora was visible at Suez on October 24th, 1870, and again on Feb. 4th, 1872, when there were great electrical disturbances over all the lines. During the last I measured earth currents equal to 170 Daniell cells upon the Suez and Aden cable. The aurora was preceded in each case by electrical disturbance on the line, and in the present case earth currents had been unusually strong for some days before, although during the actual time of the greatest disturbance on other lines the Suez-Aden section was clear."

ABSTRACT OF PATENTS.

4613. Needle-sounder for Electric Telegraph Instruments, *F. M. Rogers.—Dated 13th November*, 1879. 6*d*.

A wire from a local battery is attached to a dial-plate, thus converting the needle into a vibrating key capable of sending currents in either direction when actuated by the commutator or by the incoming current from the distant station. The ivory pins to control the vibration of the needles are replaced by platinum pins insulated from the dial-plate, and connected with one or more magnets having light armatures capable of giving a sound when actuated or released by a current sent round the coils of the magnets. A switch enables the sounder or needle to be cut out of circuit.

4846. Substitute for Gutta Percha, &c., *E. Mourlot.—Dated 27th November*, 1879.—*(Not proceeded with.)* 2*d*.

The bark of birch is distilled over an open fire, and leaves behind in the retort a black liquid which solidifies in coming into contact with the air. This substance is used as a substitute for gutta percha.

4879. Separation and Utilisation of the Tin and Iron in Tinned Iron Waste, *A. Gutensohn.—Dated 28th November*, 1879. 4*d*.

This consists in the application of a current of galvanic electricity generated in a battery of which at least one element is formed by the waste materia and solutions of salts obtained therefrom.

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Aug. 18.		Business Done Week Ending Aug. 18. Highest.	Lowest.
Anglo-American Ordinary	65¼,	⅜	66	64
Do. "B"	97⅛,	98	97¾	95⅛
Do. "A"	36¾,	37¼	37½	36
Brazilian	9 1-16,	3-16	9 3-16	9
Cuba	9½,	10	9¾	9¾
Do. Ten per Cent. Pref.	16½,	17½	—	—
Direct Spanish	1⅜,	2¼	—	—
Do. Ten per Cent. Preference	11¼,	⅜	11⅜	11⅛
Direct United States x d. Aug. 13	12 9-16,	11-16	12¾	12¼
Eastern	9⅞,	10	10	9 11-16
Do. Six per Cent. Debenture	103,	106	—	—
Do. Five per Ct. do. 1899	102,	105	104	104
Do. Six p Ct. Pref.	12¾,	13⅛	13	12⅝
Eastern Extension	9⅞,	10	10	9¾
Do. Six per Ct. Deb	106,	108	107½	107
German Union	9½,	⅜	9⅝	9⅝
Globe Telegraph & Trust x d. Aug. 13	7,	⅛	7⅛	6 11-16
Do. Six p Ct. Preference x d. Aug. 13	12½,	⅝	12¾	12½
Great Northern	9⅝,	⅞	9⅞	9⅝
Indo-European	24½,	25½	—	—
Mediterranean Extension	2⅞,	3¼	3⅛	3
Do. Eight per Cent. Preference	10⅜,	11¼	10⅞	10⅞
Reuter's	9½,	10½	—	—
Submarine x d. Aug. 13	241,	248	251½	241½
West India and Panama	1 11-16,	13-16	1⅞	1⅛
Do. Six per Cent. 1st Preference	7⅜,	8⅛	7 15-16	7⅞
Western and Brazilian	7¼,	¼	7½	7
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	—	—

TRAFFIC RECEIPTS FOR JULY, 1880.

Companies.	July, 1880.	July, 1879.	Increase.	Decrease
Cuba Submarine Company	2,800 estd.	2,932	—	132
Direct Spanish Telegraph Company	1,423	913	510	—
Eastern Telegraph Company	45,279	35,789	9,49	—
Eastern Extension Telegraph Company	32,194	23,411	8,7	—
Great Northern Telegraph Company	23,560	—	—	—

ADDRESSES.

*** NOTICE.—It has been decided to devote a portion of the advertising space of *The Electrician* to giving the addresses and specialities of the principal firms of Electricians, Engineers, &c. A moderate charge per annum will be made for the insertion of such addresses weekly, and firms desirous to be included in the list are requested to apply to the Manager, 396, Strand. The addresses must not occupy more than five lines.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

BRITISH ASSOCIATION for the ADVANCEMENT of SCIENCE,
22, Albemarle-street, London, W.
SWANSEA, AUGUST 25—SEPTEMBER 1.
President Elect,
ANDREW CROMBIE RAMSAY, Esq., LL.D., F.R.S., V.P.G.S., Director-General of the Geological Survey of the United Kingdom and of the Museum of Practical Geology.

The Journal, President's Address, and other Printed Papers issued by the Association during the Annual Meeting will be FORWARDED DAILY, by post, to members and others unable to attend, on application and prepayment of 2s. 6d. to the Clerk of the Association, Mr. H. C. STEWARDSON, Reception Room, Swansea, on or before the first day of the meeting.

ALEXANDRA PALACE, N.

GREAT INDUSTRIAL EXHIBITION,
from SEPTEMBER 4th.
MEDALS and other PRIZES to the value of £200.
ENTRIES CLOSE SATURDAY, AUGUST 21ST.
For schedule, particulars, &c., apply to
MR. J. S. COOKE, Secretary,
Alexandra Palace, N.

TO ELECTRIC LIGHTING COMPANIES and Others.

The STREETS COMMITTEE of the COMMISSIONERS of SEWERS of the CITY of LONDON will meet in the GUILDHALL of the said City on FRIDAY, the 10th September, 1880, at 2 o'clock precisely, to receive TENDERS for LIGHTING by means of the ELECTRIC LIGHT, as an experiment—

New Bridge Street,
Queen Victoria Street,
Queen Street Place and Queen Street,
King William Street,
Poultry,
Cheapside,
St. Paul's Churchyard (North Side).
Ludgate Hill,
Blackfriars Bridge,
Southwark Bridge,
London Bridge,

Agreeably to printed conditions to be obtained at this office on payment of two guineas (which will be returned upon a *bonâ fide* tender being sent in).

The tenders are to be on the forms to be had here on application, and are to state the terms for six months and also for twelve months, from the 1st of November next, burning from sunset to sunrise, also from sunset to midnight.

The tenders must be sealed, endorsed "Tender for Electric Lighting," be addressed to the undersigned, and delivered at this office before 2 o'clock on the said 10th of September.

Parties making proposals must attend personally, or by a duly authorised agent, at 2 o'clock on the said day.

The Commissioners do not pledge themselves to accept the lowest or any tender.

HENRY BLAKE, Principal Clerk.

Sewers' Office, Guildhall, 16th August, 1880.

TWO MECHANICAL ENGINEERS having a knowledge of electricity, telephones, &c., and fixing of same, require ENGAGEMENTS.—Address, B.B., 31, Cottenham-street, Upper Brook-street, Manchester.

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

ELECTRICAL AND SCIENTIFIC APPARATUS.—WHOLESALE MANUFACTURERS OF ELECTRIC BELLS, ELECTRIC REVERSING INDICATORS, and CONSTANT MANGANESE BATTERIES. Telephone Switches and Transmitters, Induction Coils and Vacuum Tubes, Terminals, Carbons, Wire, and all materials. Instruments made, repaired, or altered on the Premises. Illustrated Bell list free. Complete catalogue two stamps. Special quotations to the trade.—DALE and CRAMPTON, Manufacturing Electricians, 4, Little Britain, London, E.C.

THE "JAMIN" PATENT ELECTRIC LIGHT.
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

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SLIP

REPAIRS OF CABLES.—The Heligoland cable, as also the cable between Pernambuco and Bahia, are again working.

THE IMPROVED MARINER'S COMPASS.—M. Emile Duchemin, the inventor of the circular compass which has been adopted in the French navy, has been made *Chevalier de la Légion d'Honneur* in recognition of his invention.

THE LEGAL AUTHORITY OF TELEGRAMS.—In the Court of Bankruptcy a few days ago a telegram from one branch of a firm in Smyrna addressed to another branch in London was accepted as sufficient authority for filing a petition in liquidation. The application was, however, granted on the understanding that a power of attorney was on its way to this country.

BRITISH ASSOCIATION.—One of the most interesting applications of the telephone yet made will shortly be ready for exhibition. We refer to the telephone line just laid down from the Velindra Reservoir to the office of the borough surveyor in the Swansea Town Hall. The distance between the two points is over seven miles. Another important illustration of the practical uses of electricity will be the lighting of the pavilion by the electric light. This work has been undertaken gratuitously by the Compagnie Générale d'Eclairage Electrique, of Paris. The lighting will be on Jamin's principle, and will be under the control of Mr. J. A. Berty, C.E.

TELEPHONIC EXPERIMENTS ON THE BREST-PENZANCE CABLE.—According to the *Temps*, a series of experiments has recently been carried out on the Brest-Penzance cable (belonging to the French "Paris and New York" Telegraph Company) with the telephones of Bell, Phelps, Gower, Edison, and Hertz. Excepting in the latter case, the trials are stated to have had a negative result; but with the telephone of Dr. Hertz the sound of the human voice was transmitted through the cable, the length of which is about 300 kilometres. These experiments, which, in the opinion of our contemporary, solve the problem as to the employment of the telephone in submarine telegraphy, were tried in the presence of the director of the French cable, the controller of telegraphic lines, several Government functionaries, and other competent persons.

EXPERIMENTAL TRIAL OF THE SIEMENS LAMP AT THE STRASBOURG RAILWAY TERMINUS.—A trial of the electric light is here being made against the perfected gas lamps of Sugg, each equal in illuminating power to 100 candles. The light from the gas burners is considered to be insufficiently diffused; and parabolic reflectors of a new form—convex instead of concave—will probably be brought into requisition. In point of brilliancy, it need scarcely be said, the electric illumination far surpasses that of the gas; whether the sum total of advantages will also be favourable to electricity, under the conditions of the trial, is a point not yet decided. The apparatus generating the electric current is worked by a 20 h.-p. engine on the Hefner-Alteneck system; and the trials are to be made with two electric lights each of the power of 1,200 candles, and six smaller ones, each of the power of 400 candles.

DRY FOG.—It has been frequently noticed during fogs near large towns that the air is not saturated with moisture, the dew point in one instance being as much as 10° C. below the temperature of the air. Seeing the possible connection between this phenomenon and the fact that the evaporation of water is greatly retarded by its surface being covered with a film of coal tar, Dr. E. Frankland, made a series of experiments on the comparative rates of evaporation of water, when freely exposed to a current of air and when covered with a film of coal tar or of coal smoke. It was found that the film retarded the evaporation from 92·7 per cent. to 66·6 per cent. The results of these experiments point out a condition of very common occurrence, competent to produce "dry fog," while they also explain the frequency, persistency, and irritating character of the fogs which afflict our large towns.

THE ANALOGY OF ELECTRIC PHENOMENA WITH THE EFFECTS OF MECHANICAL ACTION.—Bodies which possess great molecular mobility, such as liquids, when submitted to the action of high tension electric currents, present phenomena analogous to those which result from the action upon the same bodies of mechanical force, particularly when this force is represented by great velocity, communicated to a small mass of matter; the relations which exist between the two orders of phenomena being more apparent in those in which static electricity is employed. A number of experiments and observations are detailed, in which physical and electrical actions were carefully compared, and the author, in summing up the views he enunciates, states that he believes that electricity may be considered as a movement of ponderable matter.—*Abstract of a Paper by G. Planté, in La Lumière Electrique.*

RECOVERY OF A CABLE.—The Eastern Telegraph Company's s.s. "Chiltern," after recovering the southern end of the 1870 direct Porthcurno Lisbon cable in 2,000 fathom, and taking the end into Lisbon, has succeeded in recovering the northern end in 810 fathoms, and splicing it on to the portion connected with Porthcurno, thus restoring the original communication by direct cable between Porthcurno and Lisbon. The result of this successful operation is to leave that portion of the original Vigo and Lisbon cable (which has lately been used to connect Porthcurno with Lisbon) available for reconnecting Vigo and Lisbon direct by cable. This restores the original system of alternate routes between Porthcurno and Lisbon, viz., a direct cable from Porthcurno to Lisbon, a cable from Porthcurno to Vigo, Vigo to Lisbon, and a third alternative route from Vigo to Lisbon by cable to Caminha and land lines to Lisbon.

ELECTRICAL APPARATUS FOR CAPTURING FISH.—At the exhibition of fishing appliances which recently took place at Berlin, a patented electrical fishing apparatus attracted considerable attention. This consisted of a kind of small boat, worked by a screw, and capable of being directed to any required point in the water. On arriving at this point the boat anchors itself, and at the same moment the hook and line are projected. The boat contains a battery and an electro-magnetic apparatus which is set in action by the closing of the circuit; this being effected by the slightest pressure upon the hook, produced by the fish in the act of taking the bait. The circuit being thus closed, the fish is "struck," and instantly hauled into the boat; a bell being at the same time rung to signify that a capture has taken place. The boat is then drawn to shore by means of a cord connecting it with the bank. The arrangement is, no doubt, very ingenious, and consequently is of some interest; but our angling friends seem to be of opinion that a "leger" line is far simpler, and at least equally efficacious, besides being preferable from the point of view of the sportsman.

TENDERS FOR ELECTRIC LIGHTING IN THE CITY.—The Streets Committee of the Commissioners of Sewers of the City of London will meet in the Guildhall of the said city on Friday, Sept. 10, at 2 o'clock precisely, to receive tenders for lighting by means of the electric light, as an experiment,

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New Bridge-street, Queen Victoria-street, Queen-street-place' and Queen-street, King William-street, Poultry, Cheapside, St. Paul's-churchyard (north side), Ludgate-hill, Blackfriars Bridge, Southwark Bridge, and London Bridge, agreeably to printed conditions to be obtained at the office on payment of two guineas (which will be returned upon a *bonâ fide* tender being sent in). The tenders are to be on the forms to be had on application, and are to state the terms for six months and also for twelve months, from the 1st of November next, burning from sunset to sunrise, also from sunset to midnight. The tenders must be sealed, endorsed "Tender for Electric Lighting," be addressed to Mr. Henry Blake, principal clerk, Sewers Office, Guildhall, and delivered before 2 o'clock on the 10th of September. Parties making proposals must attend personally or by a duly authorised agent at 2 o'clock on that day.

Swansea in 1838 and in 1880.—The *Western Mail* observes that but few of the *savans* who attended the last meeting of the British Association at Swansea will be able to be there on the present occasion. Those, however, who do revisit the town will see a vast change both in it and the surrounding neighbourhood. In 1838 the journey from London had to be accomplished either by road or sea, and was perforce one of tedious length. Now there is a comfortable railway, albeit the slowest in the kingdom, to bring them to the place of meeting. Then the population of the place was less than 30,000; now it is over 70,000. Then there was little beyond the natural beauty of the neighbourhood, and the quaint old-fashioned port to recommend the town. The visit of the wise men was professedly one of a missionary character. They thought that they were carrying the light of science among an ignorant and barbarous race of mountaineers and miners. Now they will see around them vast congeries of manufactories where the most recent discoveries of science find their practical application. In the chemical works, in the copper works, in the silver works, in the steel works of the town, Swansea will have something to show from which many of her visitors will be able to pick up a wrinkle and go away wiser men than they came.

Influence of Magnetisation on the Tenacity of Iron.—This subject has been recently studied by Signor Piazzoli. Iron wires were hung between two hooks and ruptured by pouring water into a vessel suspended from them. They were about 350 mm. long, and were enclosed in a spiral with four windings one over another, which were either all traversed by a current in one direction, or two by a current in one direction, and two by an equal opposite current, so that in both cases the wires were equally strongly heated by the spiral; but in one case they were magnetised, in the other not. The weights required to break wires annealed in charcoal—the weight of one metre being G = 0·299gram—were, during magnetisation, P = 1260-1300; without magnetisation, P^1 = 1213-1270. In the case of wires annealed in carbonic oxide —where G = 0·46 g·—P = 1732·4-1742·7; P′ = 1703·62-1719·87. In the case of wires annealed in hydrogen P = 1289·5-1310·1; P′ = 1263-1299·7. In each separate series accordingly the difference P—P′ was frequently less than the difference between the highest and lowest weights required for rupture of apparently identical wires; still, the mean values in each of the fourteen series were from about 1 to 3 per cent. greater for the magnetised than for the unmagnetised wires, showing that the tenacity of iron increases on magnetisation.

Electric Time Telegraphs. By L. H. Speller (*Journal of the Franklin Institute*).—Electric clocks are of two classes; the one employing an electro-magnetic pendulum, and the other consisting of an electro-magnetic time telegraph—the latter merely receiving the time telegraphed, and consisting of a standard clock, which in certain intervals of time completes or breaks the circuit of a battery; such instruments work well if the action of the armature is only required about once a minute, but if repeated every second or two the working parts soon become damaged, and their correctness impaired. In obviating these evils, the writer devised an entirely new arrangement. Instead of one armature, a number of armatures are fastened at equal distances round the circumference of a wheel, and on the same axle is another wheel, having as many cogs as the first wheel has armatures. Above is arranged an oscillating lever, pivoted at one end and counterweighted at the other, and supporting at its centre a pulley which bears upon the cogs; below the wheel a powerful electro-magnet is arranged, connected with a battery whose circuit is closed and opened by the oscillation of a pendulum. When closed, each armature is in turn attracted by the magnet, the wheels are moved, and the pulley rises to the highest part of one of the teeth. As soon as the circuit is opened, the pressure of the pulley against the cog moves the wheel slightly, bringing the next armature to be acted on near to the magnet, so that the electro-magnet and the pulley interchange their action and keep the armatures revolving, as the pendulum connects and disconnects the current. The result is that there is no sudden check to the armature, but when attracted it swings for a moment, in short vibrations, over the magnet before it comes to rest, and it is comparatively noiseless in its movements, its sound being hardly perceptible.—*Trans. Inst. Civil Engineers.*

Electricity at the Brussels Exhibition.—Although, at the national exhibition to celebrate the fiftieth anniversary of the independence of Belgium, electricity is not so well represented as some other important branches of science and art, there are yet a goodly number of interesting exhibits under this heading. Foremost amongst these is the electrical railway of Siemens, which has been established on a small scale in the garden attached to the exhibition building, and is constantly surrounded by a crowd of visitors curious to understand its *modus agendi*. In the direction of electric lighting, the Jaspar lamp, which in Belgium occupies a similar position to that of the Serrin lamp in France, is very conspicuous; forty lamps on this system being employed for the illumination of various portions of the exhibition. The arrangements for lighting the *salle des télégraphes* merit special notice. The principal room is a rectangle 12 by 18 metres, with a somewhat low ceiling. Two Jaspar lamps suffice to illuminate this with a soft fixed light, devoid of shadow. To obtain this result, the light is thrown upon the ceiling by the aid of suitably disposed reflectors; so that the luminous focus itself cannot be perceived from any point in the room. There is another smaller room lighted by a third Jaspar lamp; the illumination being obtained by successive reflections, illustrating in some measure the principle adopted by Messrs. Molera and Cebrian. Six lenses, placed in a circle on a level with the focus, project beams formed of parallel rays on to the same number of mirrors, which reflect the light upon those portions of the enclosed space which most require to be illuminated. One of the beams is twice reflected, and ultimately finds its way into a small office which otherwise would have been plunged in obscurity. The liberal supply of light, unattended by any corresponding quantity of heat, is much appreciated by the *employés* in the edifice. The exhibitions of the telegraph apparatus present few novelties; one exception being, however, a well-arranged waggon for the transport of the *matériel*

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and apparatus required for military telegraphy. Several of the other exhibits will require special mention on another occasion.

On the Influence of Temperature on the Electric Conductivity of Carbon. By W. Siemens (*Monatsbericht d. K. P. Akademic dor Wissenschaften zu Berlin*, Jan. 1880).—Matthiesen, in 1858, made known ("Pog. Ann.," ciii., 428) that the conductivity of gas-retort carbon increased with the temperature, giving its specific conductivity referred to quicksilver as unity, as 0·0236, and its coefficient for temperature between 0° and 140° Centigrade as 0·00245 per degree. Beetz found the conductivity to increase with the temperature only in the case of the so-called artificial carbons, and to decrease with the bars of retort carbons. His supposition was that in the artificial carbons the small particles of carbon dust were, by the expansion at the higher temperature, pressed closer to one another, and thus the resistance decreased; but the author remarks that as the expansion occurs in all directions the particles are not, therefore, more closely associated; and in experiments made by him to determine the resistances of artificial carbons when subjected to end pressure, no difference was found when the pressure was increased after it was sufficient to form good contact. Auerbach, in his experiments, found carbon to follow the law of metals, that is, its conductivity to decrease with increase of temperature. In the author's experiments made to determine this point, a good contact with the carbon-rod was established by coppering the ends of the rod, connecting to them a thick copper wire by a few turns of thin wire, and then depositing copper again upon the wire and first deposit. The temperature of the rod was then altered at will in a bath of petroleum or melted paraffin, temperatures up to 270° Centigrade being thus obtainable. The carbon-rod was also inside a copper tube, from which it was insulated by supports at each end, being raised to the temperatures at which tin and zinc would melt on the outside of the tube. The results in every case showed that the conductivity increased with the temperature. The coefficient found for gas-retort carbon was 0·000345 per degree, and for artificial carbon 0·000314 and 0·000301 for two samples of French manufacture. Dr. Werner Siemens considers that the results of Auerbach were vitiated by his method of making connection with the carbon-rod, viz., by dipping the ends in molten lead and soldering his wires to the adherent lead; the error being produced by a thin layer of air between the lead and carbon; and this he found to be true by testing the effect of temperature on a rod when so connected; the conductivity being then found to decrease with rise of temperature. The author considers that an analogy is established between carbon and tellurium and selenium. Selenium, by rapid cooling from the molten state, becomes a non-conductor, as carbon in the form of the diamond. If heated to 100° Centigrade it becomes crystalline and a conductor, the conductivity increasing with the rise of temperature. If maintained in its amorphous state near its melting point (200° Centigrade) for some time, it gives up latent heat, and at the same time its conductivity increases. The author asks, may not coke-carbon be an allotropic form, containing latent heat, of a hypothetical metal carbon; the behaviour of the positive and negative carbons in the electric arc also supporting the hypothesis.—*Trans. Inst. Civil Engineers.*

Patents.—We have before us the specification, No. 4,613, dated 13th November, 1879, of Mr. F. M. Rogers, relating to a "Needle-sounder for electric telegraph instruments." The invention "is intended to enable the ordinary needle telegraph to appeal to the ear as well as to the eye of the clerk." The ivory pins ordinarily used to control the play of the needle are replaced by pins of platinum or other non-oxidizable metal by which the current passes, and the inventor "prefers to employ a ferrule, surrounding the pin, composed of carbon or some other substance which, when decomposed by the intense heat of the spark, shall form a gaseous oxide." The metal pins with their ferrules are soldered to strips of brass, from which wires lead to the sounder or sounders; the magnets composing which are fitted with light armatures. In order that the beat of the needle to right or left may be clearly rendered by the sounder or sounders, the armatures strike against pins composed of brass, ivory, wood, china, or any substance that, when struck by the armature, will give a decided sound. Another specification, No. 5,126, dated 15th December, 1879, is that of Mr. W. White for "Electric signalling apparatus for use in the loading and unloading of ships." This invention which received provisional protection only, relates to new or improved electric signalling apparatus, to be used in the loading and discharging of ships or vessels, for conveying messages or instructions from the foreman or person directing the loading or unloading operations to the engineman or attendant in charge of the hoisting, hauling or lifting gear, by means of visible and audible electric signals instead of, as heretofore, by the confused method of calling or shouting to the attendants. A third specification, No. 5,119, dated 13th December, 1879, is that of Sir James Anderson, Kt., and Francis Strudwick Harwood, both of Old Broad-street, in the City of London, for "Improvements in Electric Telegraphs." The improvements are effected when working duplex—1st. By applying that pole of the battery required for the signal to be made through a suitable key direct to the cable itself without the intervention of any resistance coils. 2nd. By providing for perfectly neutralizing or "wiping out" the effects of induction in the cable by applying to it after each signal an induced current of the opposite sign, graduated to be of exactly the same potential and duration as the induced or "return" current that is set up in the cable by the application of the currents of the signalling battery. 3rd. By avoiding the use between the signalling battery and the cable in sending, or between the cable and the receiving instrument in receiving, of any resistance coils in a position to cause retardation to the signals by passing the signalling currents through them. To obtain these several results the inventors substitute for the resistance coils forming what is known as the "fork" a pair of condensers or accumulators suitably adjusted and coupled, one plate or side of one condenser or accumulator being connected to the artificial line or cable, and the same side or plate of the other condenser or accumulator to the true line or cable, whilst the other sides or plates of both condensers are coupled together and through the receiving instrument to earth. The artificial cable at the sending of each signal is connected to one pole of the sending battery, whilst the true line wire or cable is connected to the opposite pole of the battery, and after each signal the artificial cable is discharged into the real cable. The inventors also claim for this invention the advantage of better preserving the constancy of the signalling system by dispensing with all resistances where most sensitive to the variations of temperature, also that when signals are required to be sent in one way only the apparatus for "duplex" preserves the best possible arrangement for "simplex," and no changes are required to be made in it or in the disposition of it. The patent for this invention has become void, by reason of the patentees having neglected to file a specification, in pursuance of the conditions of the letters patent.

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SIGNS OF PROGRESS.

Although, as we have pointed out again and again, the records of the Patent Office are not to be taken as indicating giant strides towards perfection, they may be taken as indicating sure progress. The perfecting of any piece of apparatus, or the application of any laws of science, is a question of time, and generally of long lapses of time. Like others deeply interested in electrical science, we regularly study its history as given by the records in the Patent Office. Here, as everywhere, the valuable has to be sought amid masses of rubbish, yet it may almost be taken as an axiom that, underlying almost every patent specification, even if it does not describe something of great value, there is an idea, or it may be ideas, which are of great use to the student. A would be inventor should ask and answer such questions as—

1. What is wanted?
2. What has been done?
3. Where is the previous work imperfect? &c.

He should aim to give simplicity instead of complexity, thus replacing costliness by cheapness, and ensuring a greater capacity for work.

If our space permitted, we could write an essay on "The Inventor," which might well be based on their work as shown by the Patent Office.

Indeed, our thoughts have been directed to this subject by the perusal of several specifications describing apparatus connected with the electric light. As, however, this is not the place, nor have we the wish to write a purely speculative essay, we shall proceed to describe some of the recent signs of progress as shadowed forth by those well-known blue-covered pamphlets.

Wise's Improvements in Electric Machines.—This gentleman wishes to produce simple and compact machines for the production of continuous or alternate currents of electricity, and he claims to have produced certain novelties. Whether this is so or not we leave our readers to judge. In his machine the stationary frame is composed of two electro-magnets, each formed of a single piece of cast iron. These magnets are firmly attached the one to the other, and the coils so wound that the poles are in the middle of each magnet. The poles are enlarged and made concave on the inner surface, in order to fit the generating cylinder as closely as possible. The accompanying figure will show the arrangement better than mere explanation. CCCC are the coils, N S the poles, 2, 2, 2, 2 abutments bolted together. The construction gives the frame a truss-like

FIG 2

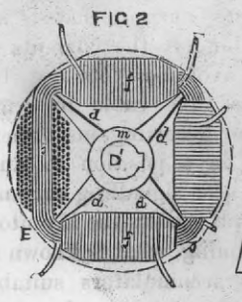
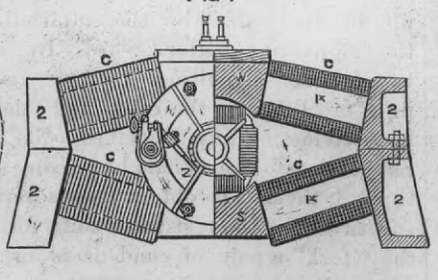
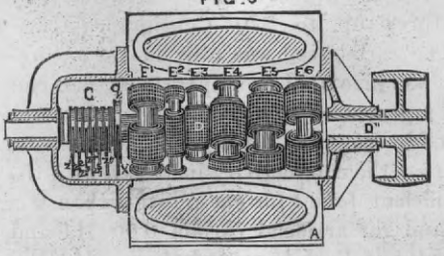


FIG 1



effect, preventing the poles being drawn against the cylinder. The generative cylinder is composed of any number of separate elements, each according to the inventor of an improved construction, as represented in section in Fig. 2, and consisting of a polygonal iron wire, *j*, which has its sides wound with insulated copper wire forming coils, *f*. The core or ring, *j*, of each element is supported by arms, *d*, radiating from a hub, *m*, upon the shaft D^1, which arms may be made of brass or other non magnetic material. The core or ring, *j*, of each element is shown as rectangular, but it may be made in any polygonal form, as hexagonal or octagonal. In order to make currents of electricity passing from the machine continuous the elements composing the generating cylinder are set spirally on the shaft, each being a little in advance of the one at its side. In forming the coils, *f*, of insulated wire upon the cores or rings, *j*, the insulated copper wire is wound in the same direction on each side of the polygonal core. These coils, *f*, are connected successively with each other; the end of the last coil is joined with the beginning of first coil, so that all the coils form a single closed circuit. Each of these joints is connected with the corresponding plate of the commutator, which is composed of the same number of plates as the cylinder has coils. All these plates are insulated from each other, and each corresponds with the coil lying in the same radius. Upon rotating the cylinder between the poles N and S of the stationary frame a current is generated in the coils, which is collected by two springs or brushes of copper wire, which touch the two plates of the commutator which lie opposite to each other and which correspond to the coils *f*, just vertically between the poles N S. The brushes are connected with the wire of the coils of the stationary frame, so that the current generated by the cylinder passing through these coils reacts on the poles N S. The remanent magnetism of the electro-magnets of the stationary frame, which derives its origin from a previous magnetisation, suffices to produce an induced current in the coils of the cylinder as soon as a rotary motion is imparted to the latter; thenceforward in circulating round the electro-magnets it is successively reinforced until it attains a maximum corresponding to the speed of rotation and the resistance of the interposed external circuit. The external circuits which should be traversed by the current are introduced at any place between the magnetising helix. The electro-magnets may be excited by the current of a separate machine, or by a part of the current derived from the machine itself, or they may be wholly replaced by permanent magnets; machines of one or more cylinders may thus be constructed, and the cylinders coupled so as to produce either quantity or tension. The currents obtained vary in their character according to the thickness of the wires, and the number of turns or coils on the cylinder. Thick wire gives quantity, thin wire high tension. In order to obtain currents of very great quantity the wires may be replaced by insulated sheet copper ribbons. The machine generates electric currents when the cylinder is rotated by any external force, and on the other hand the cylinder rotates and transmits force when the machine is excited by an electric current obtained from a battery or from another magneto-electric machine; hence it may be employed either as a generator of electricity or as an electromotive engine, and applied advantageously to the purposes of electrotyping, the production of electric light, and the magnetising of the axles and wheels of locomotive engines, or used as a transmitter of force to any desired distance. A machine for the production of alternative currents is illustrated in Fig. 3 in longitudinal section. The stationary frame of the machine may be made of wrought or cast iron. It may be composed of two or several pieces, and is wound with wire forming coils connected with each other so as to form the poles when an electric current

FIG. 3



passes. D is a rotatory generating cylinder mounted on a central shaft, D^1, supported in bearings extending from the frame A. The said shaft is also provided with a pulley which may receive a belt for rotating the shaft and generating cylinder. The generating cylinder, D, is composed of a number of separate elements, E^1, E^2, E^3, E^4, E^5, E^6, each consisting of a polygonal core or ring, which is preferably made of soft wire, and which has its sides wound with insulated wire forming coils. The core or ring, *j*, of each element is supported by arms, *d*, radiating from hub *m* upon the shaft, D^1, which arms may be made of any metal other than iron. The core or ring, *j*, of each element is similar to that described in the continuous current machine. In order to obtain a continuous action the elements composing the generating cylinder are set spirally on the shaft, each being a little in advance of the one at its side. In the coils the wire is wound in different directions on alternative sides of the cores or rings, and its two ends are connected to the commutator rings. The commutator is constructed with a sleeve insulated from and secured upon the shaft D^1, so as to rotate therewith, and composed of a series of segments, s^1, s^2, s^3, s^4, all insulated from each other and corresponding in number to the elements in the rotary generating cylinder. To these segments are connected the wires leading from the elements, the wire *i* of the element E being connected to the segment s^1, the wire i^2 of the element E^2 being connected to the segment s^2, the wire i^3 of the element E^3 being connected to the segment s^3, &c. The commutator, G, comprises also the same number of rings, r^1, r^2, r^3, r^4, insulated from and secured upon the segments, and also insulated from each other. Each ring, however, is connected with one of the segments, so as to receive the electric current therefrom; thus the ring r^2, by segment s^2, with E^2, &c. The commutator comprises furthermore a ring, *q*, perfectly insulated from all other parts of the commutator, but connected by the wires with all elements, E, of the cylinder. In order to collect the current

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there is rubbing upon each of the rings r^1, r^2, &c., a brush, and upon the ring q the brush x. To each brush, Z, can be attached one external circuit leading, for instance, to a lamp, but all these circuits have to return to the brush x. To operate this machine the electro-magnets of the stationary frame have to be excited by a continuous current of a battery or of a dynamo-electric machine, and the generating cylinder has to rotate with great speed, whereby currents of alternative sense are obtained in each circuit connected with the branches Z and x. By a modification the machine magnetises itself without the aid of a generator.

The invention of Mr. ZANNI, entitled "Improvements in and relating to apparatus for automatically opening and closing electrical circuits, chiefly designed for use in the electro-deposition of metals" deserves mention, since it completely obviates the possibility of a misfortune to which those using dynamo-electric machines for the deposition of silver, nickel, &c., have been liable. This misfortune consists in the re-solution of the deposited metal, and sometimes in the partial solution of the various articles intended to form the cathode within the depositing bath, by reason of a reversal of the current, which occurs when from any cause the action of the machine is interrupted even for a short period of time. The articles to be plated then become the anode, or act as the positive element of a voltaic couple; whilst the plates intended to be the anode take the part of the negative element. The action of this secondary battery, constituted by the electrodes, being temporary, would not of itself be productive of detrimental results; but the current generated reverses the polarity of the electro-magnets in the dynamo-machine, the consequence being that when this is again started, its current is reversed, and the above-mentioned result occurs. Mr. Zanni's invention "provides simple and effective means for preventing this reversal of polarity." According to his arrangement, the circuit is closed by the intermediary of an electro-magnet which is excited by a small magneto-machine connected with the engine which drives the large dynamo-machine. Of course, when the engine stops, the small machine ceases to act, the electro-magnet loses its power, and its armature, springing back, instantly breaks the main circuit. The means employed may be susceptible of being somewhat simplified; but the invention in its present form is absolutely efficacious for the purpose in view.

PROGRESS OF THE ELECTRIC LIGHT.

Edison's electric light has, we learn, behaved very well on its trial trip in the new steamship "Columbia," built for the Oregon service, and we do not despair of a certain measure of success for the Menlo Park inventor. Mr. Guest's improvement, whereby the platinum electrodes are let into the vacuous globe by means of a fluid mercury joint instead of hermetical sealing, will probably obviate the bursting of the globes from unequal expansion, due to the contact of platinum and glass. The disintegration of the carbon loops is, of course, a more invidious enemy, but the mercury joint may enable new loops to be more readily supplied than when the globes were sealed up. Incandescent lights are undoubtedly the best hitherto found for domestic illumination, but unfortunately their cost is against them. Werdermann's lamp is about to receive an important impetus on the Continent. A company is being formed in Paris, with a capital of fifty millions of francs, for the purpose of developing the invention in all parts of the world, but more immediately on the Continent and in the United States. The plan to be pursued is closely in imitation of that adopted by the gas companies. Persons desirous of having their premises supplied with the electric light will not be put to the trouble of having any machinery on their premises. They will merely have to pay for the fittings, as in the case of the gas supply, and a simple wire will convey the electric current into the building, whether it be a dwelling house, a place of business, or any other kind of establishment. This promises to come nearer than anything hitherto known towards giving a domestic supply. For this purpose the Werdermann light seems specially adapted, owing to the extent to which it is capable of subdivision. When shown in England some time ago, this form of electric light, although beautifully steady, seemed deficient in strength. Since that period M. Gramme has devised a dynamo-electric machine which has notably increased the power of the Werdermann light. A short time back a trial of the new Werdermann light was made on some riverside premises near the Blackfriars-road, when the light was made much more powerful than before, and it was remarkably under control. M. Werdermann states that he has had as many as eighty lights in one circuit. At the works of Messrs. Weyher and Richmond, at Paris, ten lights are said to have been maintained in one circuit with the expenditure of 4·43 horse-power, each light being equal to 330 candles. At the steel foundry of M. Pousard, at Creil, the Werdermann light is the only illuminant employed. Twelve lights are maintained on a circuit of 600 metres, with an expenditure of 6 horse-power. In Paris, thirty lights of 300 candles each have been maintained by means of 12 horse-power. As a rule, it is reckoned that ½ horse-power will maintain a Werdermann light of 300 candles. Eighty lights of 200 candles each are said to have been maintained in a series of four circuits with an expenditure of 14 horse-power.

The Jamin candle, and likewise the Jablochkoff, in fact, electric lighting generally, will benefit largely by the recent improvement in the Gramme machine. Jablochkoff's light, notwithstanding the adverse criticism it has encountered and the number of rival systems, keeps its ground in advance of all others, and is steadily being introduced at a great number of places all over the world, from the theatres and squares of Paris and St. Petersburg to the palaces and gardens of Persia and Timbuctoo. In a recent number we chronicled the advent of an English company (the Electric and Magnetic) to work the Jablochkoff patents; and the Jamin Electric Light Company is another in the field. The British Electric Light Company have acquired an interest in the Crompton electric lamp, and the principal use to which they have yet applied it is the lighting of St. Enoch Railway Station at Glasgow. Here there are six Crompton lamps suspended over thirty feet above the platform, and shedding their light downwards by means of octagonal reflectors devised by Sir William Thomson. This beginning at St. Enoch's will, probably, be followed by the introduction of the light at other large termini, for the electric light is far better adapted for termini with high roofs and ample areas than such confined spaces as the underground wayside stations, owing to the fact that when the lights can be placed high, and their beams blended by reflectors, the shadows thrown upon the platform are less dark and distracting. Another new company, formed for the purpose of supplying apparatus for electric lighting, is the Electric Generator and Light Company, a development of the firm of Messrs. Latimer, Clark, Muirhead, and Company. They are the makers of Professor Perry's dynamo-electric machine, which is said to comprise several important improvements. What with the lights above mentioned, and those of Siemens, Brush, Rapieff, and others, there is no lack of progress; fresh patents are still being taken out, and altogether the future of this new electric industry is very hopeful.

THE MEXICAN CABLE.

A telegraph company has been formed in America, styled the Mexican Telegraph Company, for the construction of a submarine line between the southernmost point of the United States system of telegraphs and the port of Vera Cruz, Mexico. The line will consist of two sections. The first, from Matamoras or Brounsville, Texas, to Tampico, will be 209 n. miles in length, and the second from Tampico to Vera Cruz, 256 n. miles. The cable for this work will be of two types, viz., main cable 505 n. miles, and shore end 20 miles. The core will be 107lb. copper and 166 lb. gutta percha per n. mile. The main cable will be sheathed with 12 No. 6 galvanised iron wires, and the shore end with 14 No. 1. The main cable will be covered with two tapes, and the shore ends with two layers of jute yarn, each type having three layers of Clark's compound. The insulation resistance at the works is to be 250 megohms per n. mile at 75° F. The cable when laid is to give after five days' submersion 225 megohms per n. mile when reduced to a temperature of 75° F. The sea temperature is to be determined by bottom tests, taken one mile from shore, at each station, and at every fifty miles, and the mean given by these several observations is to be considered as the temperature.

The work was tendered for by the Telegraph Construction Company, Messrs. Siemens Brothers, and the India Rubber Gutta Percha and Telegraph Works Company. The last-named company has obtained the contract.

Mr. Stearns, known in England principally in connection with his system of duplex working, is the engineer for the Mexican Telegraph Company, and has charge, on the part of the Telegraph Company, of the testing of the cable and the arrangements for maintenance, &c. The cable is to be laid before the end of the year, and this operation will be carried out from the India Rubber Company's steamships *Dacia* and *International*, under the superintendence of Mr. R. K. Gray, engineer to the contracting company.

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"ALL-ROUND ELECTRICIANS."

That we feel it necessary to explain the meaning of the title we have chosen for this article is an illustration of the particular unlikeness between electricians of the old school and electricians of the new, to which we desire just now to invite the serious attention of our readers. When we speak of a man as an "all-round" engineer or an "all-round" telegraphist, we mean that he can turn his hand to anything comprised within the terms respectively of engineer and telegraphist. "All-round" certainly does not mean, as some people seem to imagine, that all is middling and nothing excellent. It is, on the contrary, a highly complimentary term, denoting that the person whom it correctly describes can be relied upon in every emergency and in any direction. He may or may not have a specialty, for general excellence is by no means incompatible with surpassing excellence; but his peculiar value lies in the fact that he is a specialist in knowing every branch of his calling thoroughly, and has never deluded himself into the belief that knowledge of one thing will compensate for ignorance of all the rest.

Now, what is true in this respect of the humblest handicraft is true, to a large extent, of the highest scientific profession; and assuredly it was at one time pre-eminently characteristic of the electrician. He was essentially an all-round man; and that his unexampled success in the sphere of electrical enterprise was due to this fact we should have no difficulty in proving. Of the embryo electrician, the electrician of the future, and of not a few professed electricians of the present, it would, we fear, be equally easy to prove that they have no such assured credential for a similarly successful career. They are not all-round men, and, what is worse, they do not care to be thought all-rounders; or perhaps it would be fairer to say that they have few inducements and fewer opportunities for becoming such. The lot of the rising electrician of to-day is cast in times very unlike those which nurtured and educated his predecessors. Necessity and an enforced experience were their tutors, books and a lecture-room are his. Such appliances as they needed were created by their own dexterous hands, guided by a quickened intelligence, whose inventiveness could never afford to sleep. But these very appliances, perfected in every detail, and finished with all the nicety that mechanism can bestow, are now the ready-made servants of the amateur. He has—or thinks he has—nothing to invent, nothing to put together; and if he presumes to suggest anything—and he is not backward at suggesting—the chances are that he will betray his ignorance of what has been done already, or, still more, of what his profession really requires.

It will be seen that we are not denying that there are plenty of reasons for the demerits of the persons to whom we are here referring; but what we are anxious to point out is, that these reasons constitute a chief hindrance to his progress. They are explanations, but they are not an excuse. What he lacks is practical experience, constant and close familiarity with the difficulties he will have to encounter, and his present danger is in looking upon text books, mathematical formulæ, and costly apparatus as sufficiently adequate substitutes. That they are utterly inadequate, everybody competent to form an opinion knows perfectly well. Handbooks, equations, and delicate tests have their proper sphere of usefulness undoubtedly, but we are not at all sure we should carry every authority with us if we were to assert that this sphere is necessarily, or even very frequently, that of the practical electrician. The all-round electrician has a well founded faith that his keen insight and wide acquaintance with facts will make good the deficiencies of his instruments. His results are, indeed, practically unassailable, though the figures may differ from the exact truth by a fraction or so. They are arrived at quickly, easily, and inexpensively, and are consequently in greatest demand. It would be invidious to comment upon the errors of mere theorists and calculators; but this much may be said, that the tests obtained by an expert with the rudest appliances will commonly find a readier acceptance than the seemingly nicer and more exhaustive results arrived at in any other way.

How, then, is the intending electrician to get his experience? Only rarely can he obtain it as the pioneers of electrical science obtained theirs. But one thing he can do, about which there should be no mistake, he can realise the fact that to succeed as they succeeded he must not be ashamed to work as they worked. If he cannot invent he can reconstruct; he can make apparatus for himself; he can follow step by step in the old paths; he can contrive electrometers, devise condensers, construct galvanometers; and, shocking as the suggestion may seem, he can make up divers batteries with any materials that come to hand. We say can; for the truth is if he cannot do this and a great deal more besides, he had better abandon the idea of becoming an electrician of any sort, either all-round or angular. The men who are now at the head of the profession were created by a process of natural selection. Beginning with some advantages of practical experience, they advanced by displaying exceptional aptitudes. If the student nowadays enters upon this career with none of those advantages, it is all the more incumbent upon him to make up for them by industry in the workshop as well as in the laboratory. If he have no mechanical skill, no fertility of invention, if his fingers are all thumbs, and his temperament always prone to

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call somebody else to help him, depend upon it he is in the wrong groove. And his case is the worse if he has been taught to set an inordinate value upon his scholastic attainments. The messes and muddles of maladroitness are discouraging enough, but the awkwardness which comes of fastidious self-sufficiency is past all hope. In the absence of those conditions which favoured the making of that race of electricians, who, in the course of nature, will die out before many years are spent, the prospects of electrical engineering are not very promising. It rests with those who are now hoping to continue the work to render the outlook more reassuring. What we have said is not intended to discourage them; on the contrary, if they follow our advice they will find their profession not merely more remunerative, but more thoroughly interesting and satisfying.

In conclusion, perhaps, we ought to mention that the old-fashioned electrician covered a vast area of operations, and that in all likelihood he was not, and is not, particularly concerned with narrowing its compass by increasing the number of his competitors. But this is a view of the situation which young men of spirit will naturally be inclined to disregard; and they will be justified in disregarding it if only they prove by their steady application, and a workaday estimate of their avocation, that they, too, deserve to be, and will spare no pains to become, like the great men who have inspired them, good practical electricians of the "all-round" persuasion.

A NEW THEORY OF TERRESTRIAL MAGNETISM.

In his memoir, entitled "The Theory of Electric Phenomena," M. Edlund has explained galvanic effects by a current of ether in the circuit, and electrostatic phenomena by condensations and rarefactions of that ether. Hence it follows that an insulating body set in motion with a speed comparable to that of the ether in the galvanic current ought to produce the same phenomena. But since, according to this theory, the material molecules act in a contrary direction, the difference between the effects proceeding from the repulsion of the molecules of ether and the attraction of the material molecules alone becomes perceptible, and, therefore, the phenomenon will only be produced in particular cases.

Starting from these ideas, M. Selim Lemström has constructed a paper tube, with two concentric walls, and capable of being rotated round a cylinder of soft iron. By means of a pair of astatic needles, with a mirror suspended by a very fine silver wire, he has succeeded in proving that the tube with hollow walls acts like a galvanic current in magnetising the cylinder of soft iron one way or the other according to the direction of rotation. The experiment reminds us of one shown by Dr. Guthrie at a meeting of the Physical Society last winter. In this there was a soft iron core simply rotated in air, a condition the reverse of M. Lemström's, who keeps the core stationary, and rotates the enclosed air round it. Dr. Guthrie's experiment was discredited at the time by the remarks of some members of the Society, but perhaps after M. Lemström's observation it will now be repeated in a more successful and unequivocal manner.

The following results are given by M. Lemström:—

1. Let r represent the distance in centimetres between the axis of the iron cylinder and the vertical axis of the pair of needles; F and B the deflections in degrees according as the tube turns in one direction or the other; L the mean absolute values of these deviations; L′ the figures calculated by a formula conformably to that of the theoretical potential, supposing the force to vary in inverse ratio to the square of the distance:—

			$\frac{F+B}{2}=L$	L′	
r	F	B	Corrected.	Calculated.	Difference.
16·0	54·15	98·03	76·1	80·7	+ 4·6
17·5	40·40	74·03	57·2	52·9	— 4·3
19·0	30·37	47·93	39·2	35·8	— 3·4
20·5	20·87	32·53	26·7	26·7	0·0
22·0	15·17	27·37	21·3	20·4	— 0·9
23·5	11·53	18·43	15·0	17·0	+ 2·0
25·0	10·98	13·33	12·2	12·6	+ 0·4

Each degree corresponds to M·16″ of arc.

By varying the speed of rotation, the following series has been proved, in which L′ is calculated by supposing the deflections proportional to the speed:—

$\frac{F+B}{2}=L$	L′	
Observed.	Calculated.	Differences.
102·3	102·4	+ 0·1
57·8	58·9	+ 1·1
43·5	43·2	+ 0·3
36·4	35·6	— 0·8
28·3	27·5	— 0·8

As it is the relative velocity between the molecules of ether in the turning tube and those of the cylinder of soft iron which produce the magnetic effect it follows that the latter will magnetise itself in a determinate manner if it be turned round its own axis in one or the other direction. Hence it follows that a magnetic body, turning in an insulated space, and, better still, in a space deprived of material molecules, ought to be magnetised just as if it were surrounded by a bobbin in which circulated a current of an intensity determined by the speed of rotation and dimensions of the cylinder.

The earth is formed in all probability of an incandescent core, says M. Lemström (rather out of tune with the latest speculations of Sir W. Thomson and others), surrounded by a cold crust, of which the thickness is 50 or 60 kilomètres. Incandescent matter loses the power of magnetisation, and therefore only the cold crust will become magnetic under the magnetising influence whatever it may be.

According to geologists the earth's crust contains about 2 per cent. of iron, and if we imagine that all the magnetic molecules are concentrated on a layer in the interior of the crust we will have a layer of magnetic matter of about 1 kilomètre thick. This layer would be a hollow sphere situated at a depth of about 30 kilomètres below the surface, and it ought to present under the influence of a certain magnetising force a magnetic moment equal to what it would have if it were a solid sphere.

The earth being a magnetic body turning in the ether space ought to magnetise itself by its own rotation, since the same thing takes place, from the magnetic point of view, as if the earth were still and space revolved in a contrary direction. If we imagine, says M. Lemström, the earth divided into an infinite number of thin layers, normal to the axis, we can choose at will one of these layers and consider any point soever in it. Let us choose the equatoral layer and the point q situated in the magnetic couch a which is taken as composed of molecular magnets. When the molecular magnet q displaces itself in the direction from west to east by reason of the rotation of the earth, a small distance $d\,s$, an effect will be produced similar to that produced by q remaining still and space moving in a contrary direction $-d\,s$. It follows that at opposite ends of a diameter running through the earth at q opposite and equal magnetic elements will exist.

Applying the well-known formula for the effect of an elementary current on a magnetic pole, and make the sum of all the elements efficacious, we get for the force, S, directive, the molecular magnet, the expression,

$$S=\frac{4}{3}\,M\,I(r-h),$$

where M signifies the magnetic moment of the molecular magnet, I the effect of an element of current of a section and length equal to unity in the plan of the equator, r the radius of the earth, and h the distance of the magnetic layer from the limits of the atmosphere.

For the total magnetic moment M in the direction of the axis of the earth, we have, paying regard to variations of the relative velocity and the direction of the force,

$$M=\frac{8}{3}\,\pi^2\,(r-h)^3\,M\cdot I.$$

These explanations, M. Lemström points out, are in accordance with the formula of Gauss, and the new theory admits of the explanation of secular magnetic variations, auroræ boreales, and magnetic storms.

A Rectification.—In the abstract of the paper by Mr. Hockin "On the determination of the position of the faults in a cable when two exist at the same time," which was published in our issue of May 1 last, p. 287, the name of M. Lenoir was erroneously substituted for that of M. Emile Lacoine, in a paragraph which should read as follows:—"Clark's cell is a suitable standard of E.M.F., and the details of the method are well worth working out. Many suggestions on the point have been made of late, particularly the method known as M. Lacoine's method." The method here referred to is described in the paper by M. Lacoine on "A new method for the determination of the distance of a fault in a submarine cable," which will be found in the *Jnl. of the Society of Telegraph Engineers*, No. X, vol. IV., p. 97.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

LECTURE I.—DELIVERED FEBRUARY 2, 1880.

(CONTINUED FROM PAGE 165.)

As regards the stretching of india rubber, there is a point at which it requires a greatly increased force to stretch it, and at this point it seems to become fibrous in texture, as you may perceive, by examining this extended sample by the aid of a magnifying lens. India rubber has valuable electrical properties, as you are no doubt aware, it being an admirable insulator, and having a great tendency to become electrical by friction.

Freshly-cut surfaces of india rubber cohere very strongly when brought into contact, and this is well illustrated by the old way of making a tube of unvulcanised caoutchouc. You see that I wrap a sheet of caoutchouc round a mandril, so that the edges project parallel to each other. These parallel edges being cut off by means of scissors, the freshly cut edges adhere, and a perfect tube is the result. Toy balloons are made in a somewhat analogous manner, as I shall illustrate in the next lecture, these being cold vulcanised afterwards.

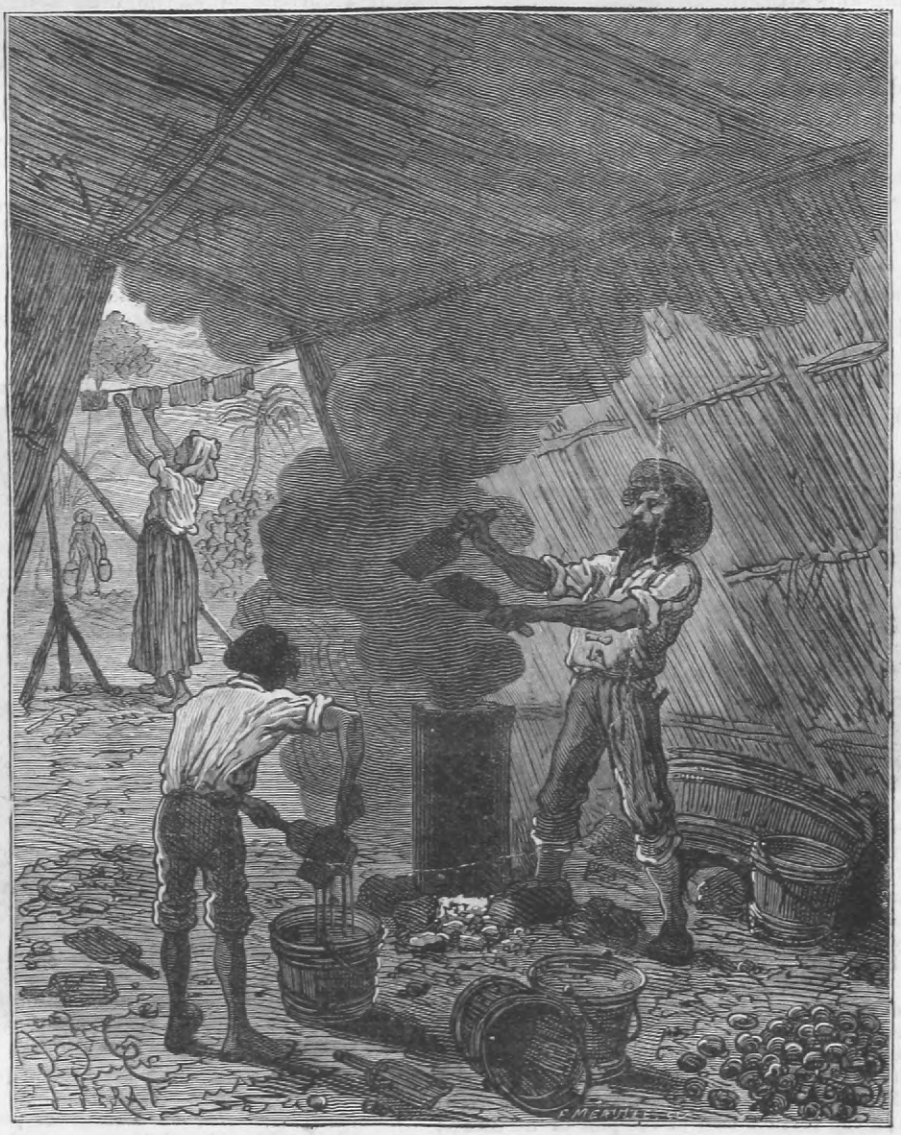
Either French chalk or soapy water is of constant use in the rubber factories to prevent the adhesion of new surfaces of caoutchouc to each other, or to other substances.

Cold has a remarkable effect on caoutchouc, rendering it rigid and inelastic, and this circumstance considerably detracts from the value of unvulcanised india rubber. Here is a strip of india rubber; you see that it is quite soft and pliable. I will now expose it for a few minutes to a temperature of 0 degree Centigrade, or the freezing point of water. It becomes, as you see, rigid and stiff, but its original pliability may be restored, either by warming or by applying sufficient tensile strain to it, to extend it to three or four times its length. One half of this strip I will warm in water, heated to 50 degrees Centigrade, and the other I will stretch. In each case you see that the caoutchouc is restored to its original condition. In the case of the stretching it is very likely that the effect is due to heat evolved during that operation. It is easy to illustrate the fact that heat is produced when india rubber is subjected to tension. Here are some strips of india rubber, arranged side by side on a board. I bring them in contact with the bulb of an air thermometer, and you see that there is no indication of either heat or cold. The strips of india rubber being now stretched to four or five times their previous length, the air thermometer indicates a considerable rise of temperature. Here is a similar set of strips, which were stretched some hours ago, and which, on trial by the air thermometer, we now find to have cooled down to the temperature of the surrounding objects. Note the effect of releasing the tension, and allowing the rubber strips to contact. You see that they have become so cold as to influence the air thermometer to a very considerable extent.

The effects of heat on india rubber present many points of interest, and, in the first place, I wish to illustrate to you the effect of moderate heat on a stretched band of caoutchouc. Here is such a band, one end being attached to an index, pointing, at the present time, to the zero of this paper scale. Notice the consequence of applying a gentle heat to the caoutchouc band—it contracts as regards its length but expands in a transverse direction, causing the index to move rapidly through a space of several degrees. This property, which stretched caoutchouc possesses, of contracting by heat, may be described by saying that, within certain limits, the tensile elasticity of caoutchouc is increased by an elevation of temperature. Caoutchouc, however, if heated to 100 degrees Centigrade, softens considerably, and almost entirely loses its elasticity, as you will perceive by examining this sample which has been heated for some hours; while a heat of 120 degrees Centigrade produces a most decided softening effect on caoutchouc of the best quality, but after exposure to this temperature, it recovers its pristine state by exposure to cold for a moderate period. If, however, the action of heat has been pushed still further, say to 200 degrees Centigd., the caoutchouc becomes converted into a permanently viscous body, which has little or no tendency to harden again. This viscous substance has the same composition as unaltered caoutchouc, and is of value as a medium for making air-tight joints, which can be easily undone. This glass jar has its top edge ground level, and, after applying a little of the heated caoutchouc to the ground edge, the jar may, as you see, be hermetically closed by a disc of plate glass. A joint of this kind may be broken and re-made with the utmost facility and rapidity. I pass the jar round, and you can study the matter for yourselves.

When caoutchouc is subjected to a temperature somewhat above 200 degrees Centigrade, it becomes converted into a variety of volatile hydro-carbons, which present many points of interest, and you will find a tolerably full account of them in the manuals of chemistry. In this retort, the dry distillation of caoutchouc is being carried on, and in time very nearly the whole of the india rubber will be converted into the mixture of oily hydrocarbons, only an insignificant carbonaceous residue remaining in

FIG. 3.



THE OPERATION OF DRYING THE INDIA RUBBER JUICE.

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the retort. The mixture of volotile hydro-carbons, often referred to as caoutchoucin, forms a very good solvent for caoutchouc and certain resinous bodies.

India rubber is subject to two kinds of deterioration and decay. In one instance it tends to become soft, and loses its elasticity, while in the other it becomes friable, yellowish, and resinous in its nature. Examples of each kind of deteriorated rubber are on the table, and you will notice that, in the case of this specimen, we have a well-marked instance of both kinds of deterioration going on side by side. The last-mentioned kind of deterioration has been clearly and indubitably traced to an oxidation of the caoutchouc. This oxidation is tolerably rapid when the caoutchouc exists in a finely divided state, and when it is exposed to damp at the same time; but the alternate damping and drying of the caoutchouc tends more towards its rapid oxidation than does a continual state of dampness. The resinous matter resulting from the oxidation of caoutchouc has been carefully studied by Spiller, who found that a sample of felt, originally composed of cotton fibres and india rubber, had become so far changed during six years as to contain no trace of caoutchouc; but in its place he found a resinous substance resembling shellac. This resinous body, of which a sample is before you, is easily soluble in alcohol, and also dissolves in benzole. Alkalies dissolve it readily, and acids precipitate it from the alkaline solution. It contains 27·3 per cent. of oxygen.

The conditions under which the softening of the india rubber takes place are not so well understood, but there is some reason to believe that this is due to incipient oxidation. Ozone oxidises caoutchouc with extreme rapidity, as Warren pointed out in 1877, and I have arranged a simple experiment to illustrate this fact. Through the open end of this glass passes a slow stream of air which has been slightly ozonised; that is to say, a portion of its oxygen has been converted into ozone. When the stream of ozonised air is allowed to impinge on a surface of india rubber, you see that the surface is instantly corroded and roughened. Again, note the effect of allowing the ozonised air to act on the surface of a distended caoutchouc balloon—you see that it bursts immediately. I should mention, by-the-bye, that in the case of these balloons, the caoutchouc is slightly vulcanised, but the action of ozone on vulcanised india rubber is similar to its action on the unvulcanised material.

It is extremely probable that the rapid deterioration of caoutchouc, which is known to take place under conditions which are not perfectly understood, is frequently due to the corrosive and oxidising action of ozone.

Ozone, or some agent nearly resembling it, is often produced when oil of turpentine is exposed to the air, and this circumstance may perhaps explain the destructive influence which oil of turpentine occasionally exercises on india rubber.

The whole subject of the deterioration of caoutchouc is one of great interest from a practical point of view, but to enter into its discussion would consume the whole of the time allotted to the present course of lectures.

Exposure to sunlight often causes the destruction of india rubber, either converting it into a soft and sticky substance, or into a hard body, less soluble in benzole than unaltered caoutchouc; and it is quite possible to obtain a photographic print by exposing a film of india rubber under a negative, and then dissolving away those parts on which the light has not acted, by means of benzole. Here is such a photograph made by Mr. Woodbury. I now project it on the screen, so that you may all see it. It is generally a discreet thing to keep india rubber where it will not be exposed to the prolonged action of a powerful light, although there are cases in which exposure to light is a useful aid to the process of vulcanisation. India rubber is, to a certain extent, porous and cellular in its texture, as may be seen by a microscopical examination of a thin section. Again, if a thin leaf of caoutchouc is boiled for a long time in water, it absorbs a considerable proportion of this liquid. You see that this piece of caoutchouc has become quite milky and translucent from the absorption of water, and it probably holds, at the present time, as much as 10 or 15 per cent. of water. The amount absorbed may, in some cases, rise as high as 25 per cent. In a similar manner alcohol is absorbed by india rubber, but this fluid is absorbed more readily than is the case with water.

Now, we pass on to a more important matter, namely, the action of such liquids as benzole or coal naphtha on caoutchouc. Here are two cubes of Para rubber, each being three-eighths of an inch across the face. One of these I will preserve as a pattern, and the other I will suspend in a bottle containing benzole. The cube suspended in the benzole will immediately begin to swell, and will continue to do so until it has attained a bulk about one hundred times as large as its original size. During the time that the cube is swelling in the benzole a certain proportion of the caoutchouc will become dissolved out, and incorporate itself with the bulk of the solvent.* Now, as a matter of fact, every kind of natural india rubber contains two distinct modifications of caoutchouc, one of which tends to swell up in such a liquid as benzole, while the other dissolves and forms a true solution. The first mentioned of these bodies may be referred to as the fibrous constituent of caoutchouc, while the

FIG. 4.

FICUS ELASTICUS; A SPECIMEN GROWING IN THE OPEN AIR AT PARIS.

* At the close of the final lecture, the cube immersed in the benzole was examined, and found to have swelled to 125 times its original volume, and in swelling it very clearly displayed the laminated texture of the rubber

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second may be spoken of as the viscous constituent. The proportions in which these two bodies occur in raw rubber varies extremely; Para rubber, of good quality, containing only a small proportion of the viscous constituent, while African tongue, on the other hand, consists principally of the viscous modification of caoutchouc. The viscous constituent of caoutchouc is the agent principally concerned in the joining together of freshly cut edges of india rubber; and as we proceed with the study of caoutchouc we shall see that, under certain conditions, the fibrous caoutchouc can be more or less perfectly changed into the viscous form. The treatment of the juice of the india rubber trees is often of such a nature as to greatly deteriorate the caoutchouc obtained; a considerable proportion being thus changed from the fibrous to the viscous condition. This kind of injury to the caoutchouc can be obviated by coagulating the milky juice, and carefully drying the clot after it has been subjected to pressure. For experimental purposes, alcohol may be employed as a coagulating agent; while, on an industrial scale, alum has been tried with apparently an excellent result. The milk is strained to remove solid impurities, after which a small proportion of alum solution is added. The clot which separates is next drained or pressed, after which it is dried. Caoutchouc dissolves more or less perfectly, according to its condition, in various liquids, among which may be mentioned the various fixed and hydrocarbon oils, chloroform, ether, and carbon disulphide. Unless, however, the caoutchouc has been masticated or otherwise degenerated, it is doubtful whether a true solution is obtained. When a clear limpid solution is required, one of the best solvents is that proposed by Payen, namely, carbon-disulphide, mixed with 5 per cent. of absolute alcohol. If one part of masticated caoutchouc is dissolved in 30 parts of the above solvent, a solution is obtained which can be filtered through paper, and may be employed in covering the most delicate moulds with successive layers of caoutchouc.

Caoutchouc may be utterly ruined by the use of impure solvents, and those experimenting with india rubber solutions should, in cases where it is desirable to regenerate the caoutchouc by allowing the solvent to evaporate, take the utmost care not to employ any solvents which contain fatty or greasy matter.

Weak or diluted acids have little or no action on caoutchouc in the majority of cases, but strong sulphuric acid slowly acts on it, the action becoming rapid if heat be applied. Strong nitric acid acts on it with some energy, causing its entire destruction, and in a similar manner it is destroyed by the prolonged action of chlorine, bromine, or iodine; although these reagents, when their action is kept under control, have a vulcanising or strengthening action, which will be referred to later on.

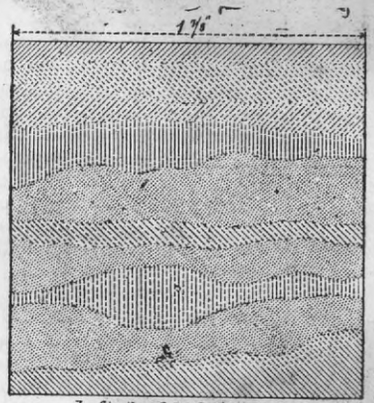
Regarding the action of sulphur on caoutchouc much is to be said, but not at present. Alkaline solutions have little or no action on caoutchouc.

bottle from which it was cut. The relative sizes of the two cubes and the texture of the swelled cube are illustrated in the following diagram :—

FIG. 5.

a. Cube of Para Caoutchouc Unswelled.

FIG. 6.



b. Similar Cube Swelled by the prolonged action of Benzole.

The angles of the swelled cube were quite sharp and well defined, the fibrous rubber having no tendency to dissolve in the benzole. If the swelled cube had been removed from the benzole at this stage and allowed to dry, it would gradually have assumed a volume slightly under its former size, and would have weighed somewhat less, owing to the loss of the viscous or soluble constituent.

(TO BE CONTINUED).

CABLE GRAPPLING IN DEEP WATER.

(From the *Engineer*.)

The history of submarine cable work has yet to be written. Thirty years ago the first submarine cable was laid between Dover and Calais. It was a cable twenty-five miles long, weighing 4 cwt. per mile, and the greatest depth of its bed was about thirty fathoms. This cable was weighted at intervals with leaden weights in order to sink it. One day's work, and its life ended; yet that short period, as one of the pioneers in cable telegraphy justly remarks, proved submarine telegraphy to be practicable. At the end of 1879, the British submarine cable companies alone owned nearly 65,500 miles of cable, made and laid by an outlay of capital amounting to over £25,000,000. Previous to 1858, cables varying in length from 200 to 500 miles were successfully laid, none, however, in deeper water than 1,500 fathoms, and mostly in much shallower seas. In 1856 Mr. Cyrus Field came to England, and the result of his visit was the formation of an Atlantic telegraph company to join the Old World and the New in telegraphic communication, by means of a cable across the Atlantic. After troubles which would have turned less earnest men from the work, capital was obtained and a cable made. On the 5th of August, 1857, the operation of laying commenced; on the 11th, after 335 nautical miles had been paid out, the cable broke in 2,000 fathoms water, and the expedition for that time failed. The next year, however, the cable was laid, and worked for 25 days, carrying during that period messages amounting in the aggregate to 4,359 words. The loss represented £415,000 worth of old and new shares. The ardour of investors was damped, and matters dragged on till 1864, when, by the exertions of men at the present time holding prominent positions in the domain of submarine telegraphy, more capital was forthcoming. Another start was made, another cable manufactured. An attempt was made to lay it in 1865, but on August 2nd the cable broke in 2,000 fathoms water. Then a determined, but for the time unsuccessful, attempt was made to recover the cable. This was the first time, probably, that any endeavour had been made to get back a cable from deep water. The recovery for repairs in shallow water was an operation of frequent occurrence. To raise a cable from 2,000 fathoms is a difficult, dangerous, and even when successful, a costly undertaking.

It will be best in the first place to attempt to realise what is required to be raised. The deep sea section of the 1865 cable weighed 35·75 cwt. per mile. It had a breaking strain of 7·35 tons, with a diameter of 1·1in. Fancy groping about 2,000 fathoms—that is, 12,000ft.—below the surface of the sea for a rope a little more than 1in. in diameter. The first thing to be done was to catch hold of the cable—a task by no means easy to the workers of 1865. This they accomplished. When, however, they caught the cable, disaster followed. A swivel gave way, cable, rope, and grapnel going to the bottom. Again and yet again, with courage worthy of success, the operators sought to raise the cable; but a second, third, and fourth breakage lost them all their tackle, and left them with no materials for a fifth attempt. Another cable was made, and, as is well known, was successfully laid in 1866. After successfully laying this cable, the Great Eastern, commanded by Captain, now Sir James, Anderson, proceeded to renew the attempt to recover the 1865 cable. If ever a writer requires to point out a good example of perseverance, he cannot do better than recount the work performed in this effort. The operations commenced on August 13th, and on September 2nd the cable was raised, and found electrically perfect. The cable was spliced, and completed to the American shore.

We have thus briefly referred to the opening history of cable grappling in deep water. The success of the pioneers of 1866 was wonderful. It proved that the sanguine opinions previously expressed as to the possibility of such work were not uttered at random; it also proved that investors need not despair because an accident happened in laying a deep sea cable. The work of raising and repairing might be arduous and costly, but it was not impossible. This proof was of the utmost importance to the interests of submarine telegraphy. Men no longer feared total loss, and since 1866 most of the 25 millions above referred to has been invested in cable work. The apparatus used in 1866 was—shall we say crude and hardly adequate for the work it was called upon to do, or shall we say rough and untrustworthy? Since then the picking up apparatus used on board regular cable ships, such as those of the Eastern Telegraph Company, or the Telegraph Construction and Maintenance Company, has been perfected, and is worthy of the attention of engineers. The evolution of the mere grappling tackle has, perhaps, been slow, but it has been sure. The grapnel used on board the Great Eastern was, we believe, that known as the long-shanked five-prong grapnel. After this came the centipede grapnel, consisting of a square bar of iron, with a ring fixed at each end, and a series of double prongs wedged into holes in the shank. These grapnels are even now in extensive use. It will be seen, however, that in dragging such

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Stationed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore (by last advices).
Telegraph Construction	ss Calabria	3,321	220	A. Hyde	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	Vigo.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Silvertown.
Telegraph Construction	ss Edinburgh	2,330	275	Seymour	East Greenwich.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Zanzibar.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	Killett	East Greenwich.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	ss Pouyier Quertier	1,385	160	Maypee	——
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Syra.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	Cato	London.
Telegraph Construction	ss Seine	3,579	500	Manning	London.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.

grapnels over a rough bottom the flukes at times engage with rocks or some other rigid resistance. The tackle, grapnel prong, or rock must give way, and in such cases the loss of tackle or grapnel cannot be valued at the mere cost of replacing. Time is a factor of the utmost importance, and the delay of a day or even a few hours represents the cost of several grapnels. Mr. Jamieson, while repairing the Para-Pernambuca cable in 1875, discussed with Mr. W. F. King the question of making a grapnel with self-relieving toes. Together they designed such a grapnel, which has been patented, and will be found described and illustrated in No. 24, Vol. vii., of the *Journal of the Society of Telegraph Engineers*. In this grapnel, which has been proved practically of great value, the toes or prongs form a lever, the short arm of which abuts on a strong spring. If the long arm engages with any rigid body, such as a rock, the force of dragging acts upon the spring, which is forced inwards, allowing the prong sufficient play to pass the obstacle.

A plan suggested in 1866 by Mr. Latimer Clark was to employ a grapnel which should grip the cable, cut it in two, and hold one end only. Mr. Clark designed such a grapnel, which so far as we know has never been successfully used. Others, however, have improved upon Mr. Clark's design, and although the resulting grapnels have not proved absolutely successful in bringing a cable on board, one or two have so far succeeded as to bring it within a few fathoms of the surface. Probably the defects in that designed by Mr. Johnson, of the firm of Johnson and Phillips, have been obviated, and when next tried it will be found to be all that is required. We may here say that Mr. Johnson's grapnel this year caught, cut, and brought a cable to the surface from over 2,000 fathoms; but the cable failed to come on board. Mr. Lambert's grapnel on a similar plan has been almost successful.

Telegraph engineers and the shareholders in cable companies have long been exercised in mind as to the length of a cable's life. Many eminent men have rather supported the theory that the length of life of a cable is about ten years, and that although a cable may work for some considerable time after this period, only in exceptional cases. They and their followers have held that if a cable of the age of ten years and upwards showed signs of faultiness, it could not be raised from deep water, and the money spent in such an attempt would be a worse act than throw it into the sea. We think it was Mr. Desmond FitzGerald who said this proposition was pure hypothesis, and maintained that under favourable circumstances no reason could be adduced why a well manufactured cable should not last a hundred years. When cables have failed, the cause has generally been easy to trace. In former times defective manufacture was added to attacks of marine insects and uneven beds. The first evil may now be said to be removed, but the life of a cable depends materially upon the others. Given, however, favourable circumstances, such as a well manufactured cable, immunity from insect attack, and a level oozy bed, we see no reason why the life of a cable should not be prolonged to the century.

The success which has attended the last persistent attempt at cable grappling in deep water has proved that a cable may be almost as good as when first laid after ten years' immersion. In 1870 a cable was laid between Porthcurno, in Cornwall, and Lisbon, the Vigo-Lisbon section of which is laid for some distance in depths of over 2,000 fathoms. It recently became necessary to raise this cable or to lose its services. The directors of the Eastern Telegraph Company—including, as they do, such men as Sir James Anderson and Mr. John Pender, M.P.—might long ago have selected as their motto *nil desperandum*. They determined not to give up the cable because it was ten years old, although the prevailing opinion was that such a cable ought to be rotten. The ss. *Chiltern*, under the command of Captain Goodsall, with Mr. C. H. Phillips, as electrician, was sent to repair the cable. The cable was caught, as we have previously said, by one of Mr. Johnson's grapnels, but it was one of the ordinary five-fluked grapnels which brought it on board. Our information is that the cable was found to be practically as perfect as when laid in 1870. The weight of this cable is 1·6 tons per mile, so that it is rather of a light type. The strain on grapnel and cable includes many factors, and, in fact, varies from instant to instant. Captain Hoskier, in his work on cables, gives formulæ which roughly indicate the factors and the strains. He represents the strain on the cable as $= v\,h\frac{(1+q)^2}{q^2+2q}$ where v is the weight in water of 1ft. of cable, h the height raised from the bottom, and q the slack, to which must be added the strain due to water friction, resistance, and that caused by the pitching of the ship. This will tend to show how delicate and difficult an operation is cable-raising from deep water, and assist us in giving due meed of praise to those engineers and electricians who have so long and so ably worked to make such operations successful.

A GERMAN FIRE ALARM.

In certain German towns there are night watchmen placed on elevated look-outs to see whether any fires break out, and to sound alarm bells in consequence; but an improvement has recently been introduced by M. Fein, whereby the alarm bells on the belfries may be rung by means of electricity, without the aid of watchmen. His system has been adopted in the antiquated town of Nuremberg, and according to a recent number of *Dingler's Polytechnisches Journal*, has succeeded very well.

To ring a heavy bell by means of a feeble current requires a particular arrangement of powerful clockwork, restrained by a detent, actuated by an electro-magnet traversed by the current. The details of the action are fully given in the journal we have cited.

When a current is transmitted from one of the stations of the watchmen, the clockwork is liberated by the attractive action of the electro-magnet on the detent, and the hammer of the bell is allowed to strike the latter successively by means of an excentric. The system is employed not only at Nuremberg but at Stuttgart. The weight of the hammer put in motion in this way is from eight to ten kilograms, and the duration of the peal is from 25 to 30 minutes. This is a very antique way of sounding fire alarms, and worthy the middle ages, but the mechanism is ingenious.

TRAFFIC RECEIPTS FOR JULY, 1880.

Companies.	July, 1880.	July, 1879.	Increase.	Decrease
Cuba Submarine Company	2,800 estd.	2,932	—	132
Direct Spanish Telegraph Company	1,423	913	510	—
Eastern Telegraph Company	45,279	35,789	9,49	—
Eastern Extension Telegraph Company	32,194	23,411	8,7	—
Great Northern Telegraph Company	23,560	—	—	—

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Aug. 25.		Business Done Week Ending Aug. 25. Highest.	Lowest.
Anglo-American Ordinary	65¼,	66	67	65¼
Do. "B"	97,	⅛	98⅛	97⅛
Do. "A"	36½,	37	38¼	36⅛
Brazilian	9 1-16,	3-16	9 3-16	9 3-16
Cuba	9⅛,	¼	9⅜	9⅛
Do. Ten per Cent. Pref.	16¾,	17⅛	16¾	16¾
Direct Spanish	1⅜,	2¼	2	2
Do. Ten per Cent. Preference	11⅛,	12	11⅞	11⅝
Direct United States	12⅜,	⅜	12⅞	12⅛
Eastern	9 13-16,	15-16	10	9 13-16
Do. Six per Cent. Debenture	106,	108	—	—
Do. Five per Ct. do. 1899	103,	106	104⅛	104
Do. Six p Ct. Pref.	12⅞,	13	13	12⅞
Eastern Extension	9⅜,	10	10	10
Do. Six per Ct. Deb	106,	108	108	107½
German Union	9⅛,	¾	9⅜	9⅜
Globe Telegraph & Trust	6⅞,	7	7 3-16	6⅞
Do. Six p Ct. Preference	12 7-16,	9-16	12⅝	12½
Great Northern	9⅝,	⅞	9 13-16	9¾
Indo-European	24½,	25½	—	—
Mediterranean Extension	2¾,	3½	3	3
Do. Eight per Cent. Preference	10¾,	11½	11¼	11¼
Reuter's	9½,	10½	—	—
Submarine	242,	249	245	244
West India and Panama	1 11-16,	13-16	1¾	1 11-16
Do. Six per Cent. 1st Preference	7¾,	8	8	7¾
Western and Brazilian	7,	¼	—	—
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	104,	107	—	—

ADDRESSES.

*** NOTICE.—It has been decided to devote a portion of the advertising space of *The Electrician* to giving the addresses and specialities of the principal firms of Electricians, Engineers, &c. A moderate charge per annum will be made for the insertion of such addresses weekly, and firms desirous to be included in the list are requested to apply to the Manager, 396, Strand. The addresses must not occupy more than five lines.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

THE RIVER PLATE and BRAZIL TELEGRAPH COMPANY (Companhia Telegraphica Platino Brasiliera).—Notice is hereby given, that the HALF-YEARLY COUPONS which fall due on the 1st September, 1880, of the £100,000 £7 per centum DEBENTURES of the above Company, will be PAID by Messrs. Glyn, Mills, Currie, and Co., Bankers, at No. 67, Lombard-street, in the City of London, on and after the 1st day of September, 1880.

The coupons must be left with Messrs. Glyn, Mills, Currie, and Co., for examination three clear days before the same can be paid.

WILLIAM PAYTON, Secretary.

No. 66, Old Broad-street, London, E.C., August 24, 1880.

ALEXANDRA PALACE.

LIGHT EXHIBITION AND MART,
SEPTEMBER 27th to OCTOBER 9th, 1880.
ENTRIES CLOSE SEPTEMBER 20th.

SECTION A.

CLASS 1. Motors suitable for Driving Dynamo Machines.
,, 2. Dynamo-Electric Machines.
,, 3. Electric Lamps and Carbons.
,, 4. Photometers especially applicable to Electric Light Measurement.
,, 5. Miscellaneous Electrical Apparatus for Sale.

SECTION B.

CLASS 1. Gas Apparatus, including Portable Gas Works, Fittings, Burners, &c.
,, 2. Candles of all kinds.
,, 3. Petroleum and Oil Lamps, and all applications of Petroleum and Oil to Lighting purposes.
,, 4. Miscellaneous Apparatus, not included in any of the above, as Gas Stoves, Oil Stoves, Reflectors, &c.

For Forms of Entry, &c., apply to
Mr. G. GROUT, Alexandra Palace, N.

TO ELECTRIC LIGHTING COMPANIES and Others.

The STREETS COMMITTEE of the COMMISSIONERS of SEWERS of the CITY of LONDON will meet in the GUILDHALL of the said City on FRIDAY, the 10th September, 1880, at 2 o'clock precisely, to receive TENDERS for LIGHTING by means of the ELECTRIC LIGHT, as an experiment—

New Bridge Street,
Queen Victoria Street,
Queen Street Place and Queen Street,
King William Street,
Poultry,
Cheapside,
St. Paul's Churchyard (North Side),
Ludgate Hill,
Blackfriars Bridge,
Southwark Bridge,
London Bridge,

Agreeably to printed conditions to be obtained at this office on payment of two guineas (which will be returned upon a *bonâ fide* tender being sent in).

The tenders are to be on the forms to be had here on application, and are to state the terms for six months and also for twelve months, from the 1st of November next, burning from sunset to sunrise, also from sunset to midnight.

The tenders must be sealed, endorsed "Tender for Electric Lighting," be addressed to the undersigned, and delivered at this office before 2 o'clock on the said 10th of September.

Parties making proposals must attend personally, or by a duly authorised agent, at 2 o'clock on the said day.

The Commissioners do not pledge themselves to accept the lowest or any tender.

HENRY BLAKE, Principal Clerk.

Sewers' Office, Guildhall, 16th August, 1880.

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

THE "JAMIN" PATENT ELECTRIC LIGHT.
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

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SLIP

MUNIFICENT.—We hear that Professor Elisha Gray has given a sum of £10,000 to the Oberlin College in which he received his education.

PERSONAL.—Mr. Jamieson, of the Eastern Company's electrical staff, has, we understand, accepted an educational appointment in Glasgow.

ACCORDING to some recent experiments of M. Goulier, the coefficient of expansion by heat of a metal is independent of any pressure put upon the metal, and is the same under a tensile strain as under one of compression.

DR. C. W. SIEMENS.—The *Universal Engineer* (Manchester) has published a biographical notice of C. W. Siemens, D.C.L., LL.D., F.R.S., in which the contributions to science of this hard-working physicist are referred to with due appreciation.

ELECTRICITY AND WAR.—Experiments are, we understand, being tried at Plymouth with an electrical range-finder, the results of which will be known very shortly, and are looked forward to with considerable interest among military circles.

STRIKE OF TELEGRAPH MESSENGERS IN NEW YORK.—The *Operator* gives full details of a very inconvenient "strike" of the boy messengers employed at the twenty-five offices of the American District Telegraph Company of New York. It would appear from what is there stated that the movement was not altogether without cause and provocation.

LIGHT EXHIBITION AT THE ALEXANDRA PALACE.—An exhibition, for the purpose of illustrating every form or means by which artificial light is produced, will be held at the Alexandra Palace, from Sept. 27 to Oct. 9, 1880. Section A. will consist of electric lighting apparatus; Section B. of gas apparatus, candles, petroleum and oil lamps, gas and oil stoves, &c.

ANOTHER TELEPHONE OUTRAGE. — Jones (telephoning wife):—"My dear, Mr. Skid will be with us at dinner to-day." (To Skid.)—"Now, Skid, you can converse with my wife through the telephone, if you wish." Mr. Skid approaches the instrument, when both hear very distinctly:—"You tell old Skid that we don't keep a hotel on washdays." Mr. Skid dined at a restaurant.—*The Operator.*

GAS CARBON FOR ELECTRODES.—It is not generally known that the first to find out the exceptional advantages of carbon cut from the retorts of a gasworks in producing the electric light was Mr. Golding Bird. In a letter to the *Philosophical Magazine* for January, 1838, describing his new induction coil, he expressly states that he gets the most brilliant sparks from electrodes of this material.

THE POST OFFICE AND FEMALE CLERKS.—The Postmaster-General announces that the competitive examinations for appointments in the various branches of the Post Office will in future be thrown open to females. The telegraph service is not specifically mentioned, but we apprehend that it is included in this philanthropic scheme, and that an accession to the number of female telegraphists may consequently be anticipated.

Mr. BISSINGER, M.E., of Carlsruhe, gives the following results as obtained in his examinations of the several motors in regard to their relative cost per horse-power for each hour. It will be observed that the examination pertained principally to small motors. The relative cost per effective horse-power per hour is as follows:—100 h.-p. steam engine, 7·6; 2 h.-p. steam engine, 44·3; 2 h.-p. Lemann's caloric engine, 26·5; 2 h.-p. Hock's motor, 40·0; 2 h.-p. Otto gas engine, 26·4; 2 h.-p. Otto Lang gas engine, 26·4; 2 h.-p. Schmidt's hydraulic motor, supplied with water from the city water works, 95·00; 2 h.-p. obtained by horses and a gin, 45·00; 2 h.-p. obtained by manual labour, 200·00.

TELEPHONIC TRANSMISSION OF VOCAL MUSIC.—The French *Journal Officiel* says that some extremely interesting telephonic experiments were recently made on the occasion of the Federal musical *fête* at Zurich. Telephonic communication having been established between the *Festhalle* at this locality and the telephonic offices at Bâle, where a numerous audience was assembled, the vocal performances of the singers were transmitted with wonderful distinctness through the twenty leagues of wire intervening between the two towns. The Bâle *Schweizer Grenzpost* asserts that the singers were heard as distinctly as if the audience had actually been in the concert room. With equal distinctness the applause of the listeners at Bâle was conveyed to the performers at Zurich.

CENTRAL AMERICAN CABLES.—We hear that the Centra American Telegraph Company intend to repair and put in working order their two disabled cables between Para on the Amazon and Cayenne (French Guiana), and between Cayenne and Georgetown (Demerara). These cables have long been out of use; but as they serve to connect the Western Brazilian Coast cables from Rio Janeiro to Para with the West India and Panama Company's cables from Demerara to Jamaica and Key West, they are important links in the chain of South American lines. The repairs will probably be undertaken by the ss. *Norseman* belonging to the Western Brazilian Company, and the electrician engaged for the work is, we hear, Mr. W. S. Seaton, late of the electrical staff of Sir William Thomson and Professor Fleeming Jenkin.

ELECTRIC LIGHTING AT GLASGOW.—The Exhibition of Gas and Electric Lighting Apparatus at Glasgow will be opened on September 28th, and continue till October 25th. Sir William Thomson's name appears on the list as a vice-chairman. Besides the manufacture of coal gas, oils, and candles, there will be a section devoted to electricity, its generation, and application to purposes of lighting, heating, telegraphy, and motive power, &c. Photometric apparatus will also be exhibited, and hydraulic motors, safety lamps, fire indicators, illuminated buoys, and many other miscellaneous articles will be displayed. It is to be hoped that makers of electric lighting apparatus will seize the occasion and make a good show of their productions. A side by side comparison of this kind is the best answer to the carping criticism of gas supporters on the merits of electric lights.

THE ELECTRIC LIGHT IN BRUSSELS.—The national *fêtes* at Brussels have been the occasion of a fine display of electric lighting in the Belgian capital. There are many boulevards and buildings in the little Paris permanently lighted with Jablochkoff's candles; but on the night of the special illuminations many thousand lamps were blazing. The magnificent theatre, which is believed to be the finest in the world, was splendid with the brilliant globes, and the front of the Gare du Nord in particular presented an enchanting spectacle. All the outlines of the architecture were pricked out with ordinary gas jets, and between these on the windows, doors, and arches were placed a great number of globes of various colours enclosing electric candles. These parti-coloured globes, some green like emeralds, others deep red like rubies, and some of sapphire blue, glowed like Aladdin's gems, and made a rich effect. Even in the Belgian fairs the enterprising mountebanks and hucksters have adopted the electric light in preference to the naphtha cresset. Is not this enough to make the Billingsgate fishmongers blush?

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ELECTRICITY IN THE CARAVAN.—The Belgian gipsies, or rather itinerant artists, would seem to be of a more ingenious and scientific body than their fellow-vagrants of this benighted country. Not only have they adopted the electric light for their spectacular purposes, but in the great country fair now being held in one of the quarters of Brussels, to commemorate old usages, there are no less than three "Female Torpedoes" to be seen. What is a female torpedo? a man is inclined to ask, not without a vague familiarity with the explosive qualities of the softer sex. On entering the booth the question is at once solved. In the centre of the enclosure there is a pit which the spectators encircle, and in this pit a woman, dressed in the habiliments of a female gymnast, walks about on a platform. Here and there she touches a spectator on the hand or cheek, and the latter receives a smart electric shock, but the woman feels nothing. Evidently she is highly charged by means of an induction coil, and the platform on which she walks is one pole of the coil. The electrified nymph is a great success, as may be imagined, and her stinging caresses elicit roars of laughter from the visitors.

THE ELECTRICAL RAILWAY.—Siemens's electrical railway is running constantly every day at the Brussels Exhibition, and earning a great deal of money. It runs under bridges, whisks round and over bridges at the speed of a fast trotting horse. The engine is no bigger than a tea-box, and the driver sits astride of it with the brake and contact lever in his hands. There are three carriages, each carrying six persons, seated back to back after the manner of an Irish jaunting car. The power being greatest when the current is let on and the coils of the locomotive are stationary, there is a sharp jerk on starting. In going up hill the driving current is also stronger than in going down hill, for the same reason, namely, that there is a greater difference between the velocity of the revolving coil in the stationary dynamo-electric machine, or generator, and that of the revolving coil in the moving machine or locomotive in the former case than in the latter. The electric railway is evidently quite a success, and we observe that an experimental line is being fitted up on the Camden and Amboy Railway in New Jersey, in order to test whether the system is applicable to the New York elevated railways.

A TECHNICAL PAPER DEVOTED TO TELEPHONY.—We have received No. 1. of the *Telephonic Exchange Reporter* (Cincinnati, U.S.A.), a paper which no doubt "meets a demand," and which it is proposed to publish monthly. The introductory article states that "exchange managers have about discovered that the experiences of the past develop but little value when applied to the startlingly new conditions of to-day. Telephonic experience stands by itself. It is not a modified experience in some other art. The art is young, and the workers few and busy beyond all belief. The worker is too much in need of the experience of others to do without it, and entirely too busy to go and gather it. To bring to each busy manager and worker some record of the work of the other ninety-nine is the chosen office of this journal. A free interchange, among managers, of opinions, of methods, of successes and failures, is calculated to advance the interests of all concerned. It is calculated to increase the profit on investment. It is calculated to increase the value of the service. It is calculated to increase the smoothness of working. It is calculated to lessen the experimental labour of all. Happily the business is such that competition does not suggest the withholding of knowledge between interested parties. Only the generous rivalry seeking superior excellence is found to exist." The *Reporter* is written in a familier style, and with a practical intent, and contains in its present issue an article on the Blake transmitter, which we think will be of value to those using this instrument. We shall be glad to have the *T. E. R.* on our list of "exchanges."

WHAT DOES IT MEAN?—The following wonderful production came to us in an envelope bearing the New Washington postmark:—

"MONETIKS.

THE HYDRO-OXY METAMON

A NEW SYSTEM OF ELECTRO-MECHANICS.

TO Electricians: The present great activity in Electro-Mechanics impells the disclosure of this hypothesis. The general theory of the Monad will be developed in a future Thesis and a special Section may be devoted to a more detailed examination of its system of Electro-Mechanics.

MATHEMATICAL THE MONAD.

The notation of this concept is composed of the terms, *Meta-Center*, and the dual *Tenseors*.

Arguement: * * * * * * * * *

Discussion of the Monad in the General Equation of Energy, and its extended physical discernation, hypothecates a new method of Dynamo-Electro, and Electro-Dynamo metamorphosis.

MECHANICAL THE METAMON.

The Mechanism: divides in two description, that of the Meta-center and that of the Tenseors.

The Meta-center: is a spherical shell containing an electrolyte. In the center of the shell is a hydro-oxy burner, thermolyticaly determineing the degree of internal resistance.

The tenseors: are a dual arrangement of Cylinders, Pistons, Valves, Regulators, motor and electro Connectors, and mechanism of detail.

The molecular action intended is the inverse migrative atomic, and gasseo-liquid cycle of dehydrogen-monoxide——H 2 O.

THE METAMORPHOSIS.

The Monetic Theory of this metamorphosis is excluded by the design of this exposition. A quantitive illustration only will be given.

A Cycle. The motor energy accreated in the hydro-oxy cylinders, is evolved from the minima maxima and mean tensions, their area and dynamical distance.

The tensions will be functions of the inverseation of loci of mass to loci of motion.

Let the unit tenseor of a metacenter be, 1 liter or cubic decimeter.

The minima tension——in atmospheric equilibrium——is per square centimeter 1000 grams, Inverseation 2000, maxima 2000000 grams, mean 1000000, and which equated with decimeter area and motion, gives in dynamical units, 10000000 gram-meters, metamorphosed per cycle.

Wm. E. Zigler."

WATER JETS AS A SOURCE OF ELECTRICITY.—Mr. J. Elster, a pupil of the celebrated Professor Quincke, is about to present a thesis, at Leipzig, upon this interesting question. The following, according to the *Journal Philosophique*, are the conclusions to which this young *savant* has arrived:—If any electromotive force whatever is produced by a jet of water there must have been contact of the particles of the water with a solid body. This condition proves that the electromotive force is produced by the friction of the particles of water with the metal, so that only a small portion of the liquid contributes to the production of electricity. Furthermore, when the rapidity of the water jet is increased or diminished, the effect obtained is proportional to the active force of the particles of the liquid, and depends also upon the nature of the body placed in contact with the water. This theory seems to be very similar to that by which Faraday explained the production of electricity in the Armstrong machine. The conclusions reached by the author are opposed to those of many *savants*, notably the Swedish electrician, Ed. Lund. 1. The movement of a liquid, of itself, cannot produce electromotive force. 2. The currents called electro-capillary are in the same case whether the fluid moistens or does not moisten the walls of the tube. In the first case the friction takes place between the adherent por-

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tion of the liquid and the molecules in motion. In the second case, the molecules of the liquid rub distinctly against the sides of the tubes. Finally, his conclusion is that the electro-capillary currents, which he claims were discovered by Professor Quincke, are identical with the currents developed by friction, which have been demonstrated by Zollner on the rubber of electrical machines.

THE EXTENSION OF TELEPHONY IN AMERICA.—When a little girl is found "playing at telephone," and reproducing to the life the "ways" of those who ordinarily profit by the new means of communication, the circumstance may be taken as an indication that telephony is in some localities becoming really popular. The following sketch of a baby telephonist, "pretending" to communicate with her papa, is from the *Concord Monitor*:—She was a pretty child, happy-hearted, full of fun, and a great mimic. Only two summers had sent sunshine across her curls and waked to sensuous delight the infantile beauty and form. She dwelt in a pleasant home filled with creature comforts, among them the new innovation, the telephone. She had often watched this wonderful mechanism, and while she neither knew nor cared for the secrets of its operation, she had learned by heart the peculiar and one-sided formula of a telephone conversation. Unheeding that some one was watching her, the other day she put up a little hand to the wall and imitated the pushing of the button on the telephone. Up went the other hand to the ear, as if holding the ebony cylinder, and the little miss went on in mimicry of her elders, in the following fashion:—

"Hello."

She then paused for an answer from the central office.

"Hello. Please hitch on Mr. —— house to Mr. —— office.

Pause.

"Is 'at you, papa?"

Pause.

"When is you coming home?"

Pause.

(Turning to her dolls, the little one here spoke impatiently, "Do you keep still; I cant't hear a word.")

"Yes." (Rising inflection.)

Pause.

"I don't know." (In doubt.)

Pause.

"Yes." (Gleefully.)

Pause.

"Why papa." (In surprise.)

Pause.

And so the little one went on, maintaining perfectly an imaginary conversation, till at last she dropped her hand with a motion indicative of weariness from holding the telephone, and pronounced the conversational "That's all; good bye," with all the nonchalance of a veteran.

THE ELECTRIC LIGHT IN THE SOUTH KENSINGTON MUSEUM.—Major Festing, R.E., who is entrusted with the charge of the buildings of the South Kensington Museum, gives the following account of the experiments of last year with the electric light:—Arrangements were made in the early part of the year with the British Electric Lighting Company for trying a Wilde's machine and lights in the Raphael Gallery and one of the Sheepshanks rooms. The machine was worked by the gas engine purchased in the preceding year. The trials, however, were discontinued after a short time, on account of the buzzing noise emitted by the lamps, which was found to be very objectionable. The promotors expected to be able to overcome this difficulty, and it was intended to have some further trials when this should have been done; but before long the company was wound up, and no further trials were made. It was found from the trials that two lamps lighted one of the Sheepshanks rooms, in which the consumption of gas is 600 feet per hour; and that six lamps gave sufficient light for the Raphael Gallery, usually lighted by a consumption of 1,800 feet of gas per hour. Apart from the noise, the light was generally satisfactory, though the lamps required rather better adjustment to make them burn satisfactorily, and to enable six of them to be properly worked by the gas engine. This better adjustment could no doubt have been effected with care, but it was not thought advisable to continue the trials with this view as long as the great defect of the noise remained. As regards cost, the motive power and carbons for this light were found to cost 2s. 6d. an hour for the Raphael Gallery, against a cost of 6s. 4d. an hour for gas. No determination of the probable cost of wear and tear of the machinery, &c., could of course be arrived at from these limited trials, but the saving of 3s. 10d. an hour, or nearly £140 a year, would certainly be ample to cover this cost, as well as the interest on the outlay for the machinery. At a later period Mr Werdermann, the inventor of another form of electric lamp, lent some of his lamps for trial in the Art Library. They were worked by a Gramme machine hired for the occasion, and afterwards by the Siemens machine, the motive power in each case being the gas engine. Neither of these machines, however, gave results satisfactory to Mr. Werderman, and at his request the trials were discontinued until he could get a machine made which he believed would answer his purpose better. He has not, however, resumed the trials as yet. The Reading Room was satisfactorily lighted by these lamps. The light was steady and of good colour, and the amount of heat given out by them being imperceptible, there was a favourable contrast to the gas lighting, which makes the room very hot. There were no signs of the evolution of any noxious vapours, but this is a point which will require further investigation. Eight of these lamps were used in the Art Library, but the best result was obtained when seven only were used at one time. They were placed at the same height above the tables, about five feet, as the gas lights, and the consumption of gas in the lights which they replaced is at the rate of about 6d. an hour. The gas consumed in the gas engine which worked the electric lights cost about 10d. an hour, and the carbons about 8d., so that these two items alone cost three times as much as the gas lighting. It must be remembered, however, that in the new Reading Room, which will be nearly 35 feet high, it will be necessary to have the gas lights about five times as far above the readers' tables as they are in the present room. The consumption of gas in proportion to the number of readers will therefore be largely increased but there will be no corresponding increase in the number of electric lamps, which may be as near to the tables as they were in the above-mentioned trials, and therefore probably the cost of even the Werdermann electric light will not be much greater than that of gas in this case, and in every other point the advantages will be with the electric light. These lights appear to be particularly suited for the Art Library by reason of their great steadiness, and it may therefore be found advisable to introduce them into the new rooms, notwithstanding the expense of working them. Trials, however, will be made of other systems of electric lighting as occasions offer, in order to determine which will answer best for other parts of the Museum. The total consumption of gas in the Museum, schools, &c., at South Kensington last year was 28,820,300 cubic feet, costing £5,044 1s. 2d. At Bethnal Green 5,224,000 cubic feet of gas were consumed, costing £941 16s. 1d.

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THE CONTINENTAL EXHIBITIONS.

(FROM OUR SPECIAL CORRESPONDENT.)

DUSSELDORF, 30th August, 1880.

The meeting of the Iron and Steel Institute at Düsseldorf last week brought many from England who would probably have not otherwise paid a visit to the excellent exhibition at Düsseldorf, even if the *fêtes* in connection with the commemoration of Belgian Independence brought them to Brussels. It was a happy thought of the German ironmasters to invite their English *confrères* to hold a meeting at Düsseldorf. The town is the centre of a district which competes with England very keenly. Ordinary readers may not have realised how closely many of the large factories are connected with electrical progress, but when, for example, the weight of iron wire used on land lines and for cable purposes each year is considered, it will be found that many firms depend almost entirely upon telegraphic requirements to keep their works going. The iron wire makers in this district not only successfully maintain their ground against English competition, but are beating the English makers by underselling them in England. Part of the cheapness of Cologne-made wire is no doubt due to water carriage; but this is not all, and English makers will do well to consider whether means cannot be adopted to place them on a better footing as regards this competition.

It may be worth while to glance at the history and prospects of the important districts included in the terms "Rhineland and Westphalia." The province of Westphalia was formed in 1815, and in 1875 had 1,905,697 inhabitants. The Rhine province is the most western and the most thickly populated of the Prussian states. In 1875 it had 3,804,257 inhabitants. The district of Weisbaden had at the same date 680,000 inhabitants. Together these form rather more than one-seventh (2-13ths) of the Prussian states, and contain about one-fourth of the population. The district is well watered, the Rhine and several of its large tributaries flowing through it. Its minerals are abundant, and large parts of its soil fertile. The population engaged in industrial occupations compared with that engaged in agriculture is about 2 to 1. This manufacturing prosperity has been brought about by the extensive use of steam in developing the production of iron and coal. Besides the collieries and ironworks, however, the textile industries take a prominent position, also glass and ceramic ware, as well as chemical manufactures.

It is this prosperous district that has carried out the idea of a local exhibition. The exhibits are for the most part unconnected with electrical matters, but there are one or two of interest to those who take cognisance only of such matters. The railway of the future—will it be electrical, or will some other manner of propulsion be invented? Thousands at Berlin tried the electrical railway of Siemens, and thousands are trying it at Düsseldorf. It may be demonstrated that the adoption of electrical railways would not entirely obviate accidents, for we were witness to the motor and carriages leaving the rails. On Monday, August 22nd—we are bound to be precise in dates—some school children were enjoying rides on the electric railway. Many train loads had been carried in safety, and great was the pleasure of the little ones. Some one, however, careless of everything except his own convenience, laid balks of timber between the rails in order to get his wheelbarrow or some such implement over. Of course the timber was too high, and left in this state as used or about to be used, without the man troubling himself of the whereabouts of the engine and carriages. It must be stated that the line is laid around a detached building in which are Krupp's exhibits, going round corners and in sharp curves, so that the driver cannot see far ahead. He did not see the balks of timber, the result being that engine and carriages left the line. Fortunately the speed was not great, the carriages did not overturn, and all the damage was spent upon engine and rails, knocking off the brushes of the engine. In fact, the accident seemed to cause more laughter than consternation, and so far as we could ascertain nobody troubled to find the stupid man who had placed balks of timber on a railway. On a real line constructed for ordinary business purposes it is almost impossible to realise that an accident of a grave nature could occur. There would in such a case be no unauthorised person to make roads for traffic here or there at his own sweet will, and, the engine being under perfect control, accidents would certainly be minimised.

Besides being employed for the electric railway, electricity was used as the motive power for a traverser intended to shift railway carriages from one line to another. We were not fortunate in seeing this traverser at work, but the attached apparatus was similar to that used on the railway. A stationary machine, driven by the steam engine, is connected to another machine situated at the point of application of the power. As in the railway, a central rail, insulated by wood, forms the conductor, the return circuit being by the two side rails. Four brushes make contact with the conductor, so that there is no danger of losing power by bad contact. It is, however, impossible to speak upon the economy of this application, or its advantage, without a long personal experience of the power used.

The only important exhibit independent of these uses of dynamo-machines is that of Messrs. Felten and Guilleaume, of Mülheim-on-the-Rhine, who show excellent specimens of their work in wire drawing. The works of this firm at Mülheim are solely engaged in the manufacture of black, bright, and galvanised wire, of wire ropes and telegraph cables, turning out 20,000 tons per annum, using steam-power up to 500 horses, and employing about 800 hands in the works, and further 300 to 500 men in laying the cables under ground.

Wire has to serve a great many different purposes, and in order to suit its many requirements it is necessary to vary its qualities accordingly. For certain purposes it is most essential that the wire should be as flexible as possible, for others it is more important to attain a high breaking strain, and then again cheapness may be the first consideration. With telegraph wire high conductivity is a valuable addition to the other good qualities of the wire. Next to the before-named qualities which are claimed for the wire material, the outward appearance of the wire is of more or less importance, such as a smooth surface, a true given section, &c., and finally the prevention of rust by galvanizing the wire or dipping it in oil. It is a pity that the good qualities claimed for the different kinds of wire cannot all be shown in an exhibition; only those that apply to the outward appearance can be judged of by ocular inspection, whereas most of those that refer to the wire material can be proved only by actual testing, which can only be carried out with properly devised apparatus, and not at an exhibition. The figures on the labels attached to the samples of wire are stated to be the results of actual tests at the works, which are provided with the most accurate testing apparatus.

An examination of the wire shows that great care is bestowed by the firm on drawing their wire of an accurate, uniform section, with a smooth surface. There are some bundles dipped in oil and others galvanised to prevent the wire from rusting, and again others have a galvanic coating of copper. This latter wire is intended for furniture springs. The different wire material is exhibited from the very commonest coke-iron up to the very best swedish iron, Bessemer, Siemens-Martin, and crucible steel. Telegraph wire may be seen to suit five different specifications. Particular attention is drawn by the exhibitors to the wire in accordance with the English Government specification.

Messrs. Felten and Guilleaume were the first to manufacture galvanised wire in Germany, and as this material has been constantly increasing in favour, the firm's galvanising plant has had to be continually enlarged, and at present their galvanising shop is said to be the largest in existence. Last year its production amounted to 15,000 tons of galvanised wire for telegraphs, cables, ship's rigging, mining, and towing ropes, fencing, signalling, and other purposes. The bulk of this wire was exported, and the firm prides itself upon being able to beat foreign competition in its own market. I cannot dwell at length upon the number of specimens of

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galvanised and other wire for mining and similar purposes shown in this exhibit, but content myself with stating that such specimens are to be seen, and that full details are given as to number of strands in each rope, of wire in each strand, diameter of rope, weight, breaking strain, &c. Patterns are shown of two copper wire ropes and one galvanised iron wire rope for lightning conductors, which Messrs. Felten and Guilleaume undertake to erect.

In the centre of the stall is a huge reel dressed in the colours of the Imperial German post-office, and wound on this reel is a length of underground telegraph cable from the Imperial German underground lines. The exhibitors direct attention to the galvanised wire rope which is wound round the reel stand. The several knots formed in this rope, and the number of short bends, show the flexibility of the rope, which consists of 798 ends of galvanised cast steel wire, of a thickness of 0·02in. The rope has a circumference of 3·94in., and a breaking strain of 18 tons 10 cwt. The German navy employ this class of rope for raising heavy anchors and screws, and they use it in many instances where hitherto only hemp ropes and chains have been employed, for instance for lifting tackle, steering gear, &c.

This cable, wound on the reel, contains seven conducting wires, and is a specimen of the cable which is employed by the Imperial telegraph office for the large German underground lines. The conducting wire is a strand of seven thin copper wires, insulated by a double covering of gutta percha. Seven of these insulated conductors are twisted into a strand and then covered with tarred jute yarn. To shield the conductors against being mechanically damaged, an armature of a number of galvanised wires is put on and a final air and water proof coating of asphalte. All the telegraphic main lines of the German Empire are provided with cables of seven conductors, and only the branch lines have cables of four conductors.

The telegraphic underground lines of the German Empire are to have a total length of more than 3,100 miles with altogether 19,000 miles of conductors, and they are hoped to be completed before the end of this year. By their means nearly all the principal towns of Germany are put into telegraphic communication with one another and with Berlin.

The first large underground telegraphic line was built by Messrs. Felten and Guilleaume, four years ago, from Berlin to Halle; this line was to serve for trial, and when it gave good results the German telegraphic authorities resolved to proceed with the establishment of the above network of underground lines. No other country having previously introduced underground telegraphy on an extensive scale, the results obtained in Germany were watched with interest. Now that the German underground lines have been proved successful, a general introduction of underground telegraphy may be expected. In France a resolution has already been passed for making a beginning with the construction of underground lines, and it is reported that 190 miles of such are to be put down this year.

A glass case attached to the cable reel contains sections of different kinds of cables, including those for crossing rivers and lakes. Each section clearly shows the construction of the cable.

THE ELECTRIC RAILWAY.—According to the *Operator*, Mr. Stephen Dudley Field, a well-known telegrapher, and nephew of Mr. Cyrus W. Field, of Atlantic cable fame, claims that he invented an electric locomotive suitable for surface or elevated railroads before either Professor Siemens, of Berlin, or Mr. Edison, of Menlo Park, had done anything in that direction. A patent was issued to Mr. Field July 13th, while Mr. Edison's patent for a similar invention has not yet been granted. Mr. Edison says that the claim is based upon the fact that Mr. Field patented a lever attachment for opening and closing a circuit, which bears about the same relation to an electric engine that a mill does to a sewing machine, and to use which there must first be a machine.

IRON WIRE FOR TELEGRAPHS.*

In the very early and palmy days of electric telegraphs materials for the construction of the lines were bought regardless of cost, but of the best quality; foreign timber was used for the poles, and charcoal iron wire for the conductors. As competition arose prices were reduced rather recklessly, without any careful specification. The consequence was that wire of such inferior mechanical quality crept into use that it would not stand the strain caused by snowstorms. The wire, tightened by the contraction from low temperature and loaded by snow, had the last straw put on its back when a gale of wind occurred. In revising the specification for the mechanical qualities, experiments were made on the conductivity of different qualities of wire, and it was found that considerable difference existed in this respect, a fact which, as regards coppe had been previously found out and provided for. Careless welds, too, were found to be a great source of breakage. The specification of the wire for the Post Office Telegraphs is now a somewhat elaborate affair. The wire must gauge within 2½ per cent. of the specified gauge, must be made from charcoal puddled bars, must stand so many twists in six inches before breaking, must have a certain tensile strength, be of a certain length without any weld, and not give more than a certain electrical resistance per statute mile. A regular table, stating the amounts of each of these qualities for the different gauges employed, is given in the printed specification.

In the same way the Indian Government has a special specification for the wire required for the Indian telegraphs. This specification, up to within about a year and a half ago, though very stringent as regards mechanical qualities, did not specify the electrical resistance, but this was at about that date supplied. The price now paid, therefore, for telegraph wire for these Government land lines is very much greater than it was before these rigorous specifications were issued, and the cost is about the same now as it was for the earliest lines, whilst at one time, intermediate between these periods, wire, cheap and bad, was supplied for about half the present cost.

The colonial telegraphs, where extensions are rapid, consume a great deal of wire, and most of the colonies follow the Post Office specifications. The English railway companies require a little wire yearly for repairs and extensions, but their specifications are not generally as rigorous as that of the Government.

For the external coating or armour of submarine telegraph cables a large quantity of wire is yearly consumed by the manufacturers, such as the Telegraph Construction Company, the India Rubber, Gutta Percha, and Telegraph Works Company, Messrs. Siemens Brothers, and Henley's Telegraph Works Company. The Telegraph Construction Company alone in one year made about 6,000 miles of telegraph cable, which would probably represent about 7,000 tons of wire.

For submarine cable wire a very different class of wire is used from that used for land lines. For deep sea work the wire known as homogeneous iron is largely used, and for the types of cable known as intermediate and shore ends iron wire known in the trade as "BB" is used. The engineers who draw up the specification for the telegraph companies specify the breaking strain of the homogeneous wire, but scarcely ever give any other specification for the iron wire than the very rough one of "BB." No tensile strength or twists to prove ductibility or elongation are mentioned for this wire. The manufacturers themselves make a few tests, but their principal test in practice is the time that the covering machines will run without a wire breaking. For this wire foreign competition has for a considerable time interfered largely with our Lancashire wire drawers. Thousands of tons come yearly from Germany to the banks of the Thames at a price which it is impossible for our English firms to quote. This is partly due to the cheaper labour in Germany, but also to the price of carriage. But it is a melancholy fact that wire can be brought from Cologne to the Thames for about ten shillings per ton cheaper than from Manchester or Warrington. It is also a curious fact that the carriage for wire from Lancashire to London for export is about half the price that it is for wire brought to London for manufacture, and it would appear to us that if it is the interest of the railway companies to bring wire cheap to London for export, it should also be their interest to bring it cheap to the banks of the Thames for manufacture into an article which is exported as soon as it is made. If the price of carriage was thus reduced, it would be, perhaps, possible for our English firms to compete with the Germans, and the railway companies would obtain the carriage of thousands of tons of wire from Lancashire to London which they at present lose. As it is, the wire trade is leaving the country, so far as the submarine cable business is concerned, and this forms a considerable item in the whole trade.

* From the *Contract Journal*.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

We cannot undertake to return drawings or manuscripts, and must, there fore, request Correspondents to keep copies.

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SCIENTIFIC EXCURSIONS.

This is the season of the year when science takes its holiday. Parliament may continue its weary labours, but nobody takes much notice of them; and the newspapers, with an intelligent regard for what the public care to read about in the hot season, at sea-side lodgings, and at country houses, are superseding the usual debating copy with full reports of the sayings and doings of leaders of learning and industry. Science is never supposed to rest, and industry is obviously unceasing; but the happy idea of taking their budget of labours to some common place of meeting and interest, far away from the scene of customary avocations, enables them to combine business with pleasure, recreation with instruction, in a way which members of Parliament, we are sure, must thoroughly envy. It is, perhaps, fortunate that the six hundred and odd gentlemen who usually meet at Westminster have on but very rare occasions adopted a similar course. In these days, we fear the visit would far outlast the hospitality. Not so with the representative men who are now the welcomed guests wherever they may be pleased to go. The local celebraties are rejoiced to meet their fellow workers, and the local nobodies are glad to get some of the reflected importance. Places of note or of beauty are visited, works are inspected, and generally the strangers as well as the residents profit considerably by the meeting. Papers are read telling, if not all that is known, all that is ripe for publicity, concerning the work that has engaged the members' attention during the past year; or facts relating specially to the industrial products and manufactures of the district are gathered together, so that the world at large makes a closer acquaintance with their capabilities and resources. We are sure that a great deal of health-giving pleasure is obtained at these meetings, and it would be odd indeed if a great deal of valuable information is not carried away also.

Last week three such annual gatherings took place, and the success of each and all was, we believe, quite exceptional. The papers were of great importance both in their scientific and industrial aspects; and when we say that they were read respectively at Swansea, Düsseldorf, and Berne, there can be no question about the interest of the localities visited. Switzerland, overawed and protected by the armies of nature, is preeminently a land of peace, and it is from her undisturbed valleys that we oftenest hear the calamities of war denounced, and proposals to soften their rigour. Amongst the suggestions, though not a new one, advocated at the conference on International Law, which met at Berne a few days ago, was one which is peculiarly interesting to the telegraph world. The outbreak of a general war has long been looked forward to with alarm by cable proprietors; and they will be glad to learn that on humane and international grounds their interests are being cared for. Sir Travers Twiss boldly supports the proposition that, outside certain narrow limits, submarine cables should be held inviolable by belligerents. We heartily wish, though we scarcely dare expect, success to this well-intentioned proposition.

Turning to the Switzerland of England, Wales has been a pleasant holiday ground for the British Association this year. If Swansea is not exactly Berne, the country round may in some respects vie with that in the neighbourhood of the celebrated Swiss halting-place. The towns, however, are in remarkable contrast. Berne remains, so to speak, unstained by its industry, while Swansea may be said to have almost forgotten that it ever was other than what it is. The river of which poets once sang still flows, but bards no longer praise its limpid waters; the hills are still as high as ever, but their slopes are not now held sacred, nor can their summits be always gazed at. If smoke and blasting, however, have somewhat marred the æsthetic attractions of this now great mineral and commercial port, its bustling wharves, its thronged streets, its crowded harbour, its busy factories, had a special charm, perhaps more pleasing to their late visitors than mere picturesqueness could have afforded. The papers read during its sojourn at Swansea by the members of the British Association were not of startling novelty; but we note that a larger share than usual was allotted to electrical subjects. Magneto-electric machines were of course under discussion, and a paper was read on some experiments in photo-electricity. Professor Thomson and Mr. W. H. Preece each dealt with subjects with which he is especially familiar; and the inspection of lightning conductors was forcibly advocated by Mr. R. Anderson. To Professor W. G. Adams fell the task of discussing the much vexed question of magnetic variations, and his surmise that they are traceable to vast changes which are observed to take place in the body of the sun, as indicated by the dark spaces or "sun spots," will be studied with much interest at the present time. These and several other papers read in the course of the meeting we commend to the notice of our readers.

Düsseldorf, like Swansea, has an abundant water-way and great mineral wealth in its vicinity. The Rhine and the Düssel, which unite under its walls, are to Düsseldorf what the Severn and the Tawe are to Swansea. The Iron and Steel Institute, which this year held its meeting at what was once the ancient capital of the duchy of Berg, has had even a better time of it than the British Association. The scene was brighter, the surroundings more novel, and, if possible, the hosts more hospitable. Of this meeting, however, we have little further to say. So far as its proceedings related, nearly or remotely, to electrical or telegraphic subjects our special report gives a full account of them. One thing, however, is to be noted, that in the field of manufactured iron, including that used as telegraph wire, this country has evidently no longer a monopoly. If a great deal of information is to be had by visiting these unfamiliar spots, and treating the journey as a voyage of discovery as well as a trip for pleasure, it must be owned that the experience is purchased at the cost of no little mortification. When we learn that one German firm alone has manufactured, and perhaps sold, no less than 15,000 tons of galvanised iron wire for the uses of the telegraphs, we ask ourselves a few questions about the unequalled resources of our own country, and the causes which hinder our finding, or rather reaching, the suitable markets for our wares. This, among many others, is an

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advantage to be got from holding meetings of the kind we are referring to on quite uninvaded ground. The weather has been most enjoyable, and we hope it will hold out for the benefit of science on its holiday, whatever it may do for legislators when they condescend to take theirs.

THE COMMERCIAL APPLICATIONS OF ELECTROLYSIS.*

BY PAGET HIGGS, LL.D., ASSOC. MEM. I.C.E.

Unipolar Machines.—The difficulties brought about by two attendant evils of magneto or dynamo-electric machines when employed for electrolytic work, have led makers to consider a means of avoiding the causes. These causes are more properly one, since they both are results of the interversion of the magnetism of the cores of the machine. This interversion, caused by the passage of the revolving coils successively before poles of opposite name, gives rise to heat in the iron cores of the magnets and needs also that the currents produced, which are of alternating direction, should be brought to one direction by means of a commutator. The heating has been got rid of in practice by passing cool air or water around the casing and coils of the machine, but the commutator still remains. The happy idea of overcoming both obstacles at once is suggested by the adoption of unipolar machines.

In some philosophical instrument makers' windows, there are still to be seen apparatus, to illustrate the rotation of a conductor around a magnet, of the following description:—

A horseshoe permanent magnet constructed from round steel bar is mounted on a stand vertically, with its pole-faces upward. In the centre of each pole-face is a pivot-point; on this pivot rotates (around its long axis) a thimble of copper or of copper wires, which passes over the pole and down the magnet limb, to about one-third of the length, being concentric therewith. Each thimble dips at the lower end into a concentric channel of mercury fitted on to but insulated from the magnet limb. From these mercury reservoirs a wire is led to one pole of a battery, and the other pole of the battery is connected to the body of the permanent magnet, the circuit branches passing up each limb of the magnet through the pivot to and down the thimbles and leaving by the mercury channels. When circuit is completed, the thimbles revolve on the axis of each magnet limb and concentric thereto, but in opposite directions.

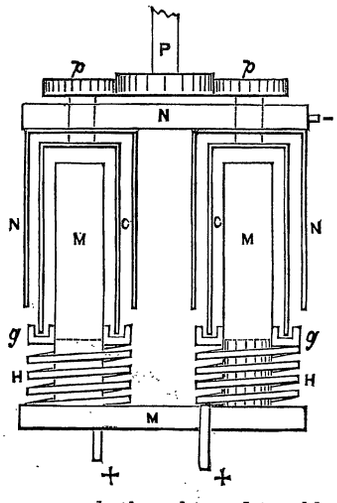
As in most other forms of electro-magnetic engines, this motor is reversible, and by imparting motion to the thimbles, in their respective directions, currents can be generated of opposed polarity to the current from the battery. It should be noted that the opposition of direction of motion, under the action of the battery current, is apparent only, since if the horseshoe were straightened out into a bar the rotation would be in one direction, regarded from one end.

This principle, which was embodied in the earliest philosophical toys, has been utilised in the building of unipolar machines by several constructors, notably by Siemens, who patented such an adaptation as recently as 1878. This machine employs the principle of mutual accumulation, as in other or bipolar dynamo-electric machines, and is constructed as follows:—

A massive iron or steel horse-shoe magnet, M, has its polar branches capped by copper cylinders, C, which are set in rotation by pinions, *p*, gearing into a driving wheel, P. N is a hollow iron magnet to increase the magnetic inductive effect, *g* is a mercury bearing at the foot of each cylinder, C, to maintain circuit. Solid copper helices, H, serve to magnetise the cores, M, by means of the current generated in the cylinders, the circuit being from + through the right-hand helix, by the mercury joint to the cylinder, and from the cylinder to the magnet base, N, which carries the terminal of the machines.

Such a machine is capable of generating enormous quantities of electricity, since the cylinder and helix resistance can be made almost immeasurably small. But the electromotive force is only that to be obtained from the combined length of the two cylinders (by insulating one of them from N), and must therefore be small. It may roughly be assumed that under maximum theoretical conditions four feet length of cylinder would be required at a reasonable rate of speed of revolution to produce an electromotive force of one volt. The chief resistance in such a machine will consist of the contact resistances, which will be much greater than that inherent to the cylinder and helix; it would, however, be easy to construct a machine having 0·0005 ohm resistance even when heated. To work this hypothetical machine to best advantage, say in the reduction of copper from an acid solution of the sulphate maintained saturated, would need that the electrode should have an area of 200 square feet at a distance of 2 inches apart, to give an equal resistance to that of the machine, or a total resistance of ·001 ohm. The assumed electromotive force of 1 volt would therefore determine a current of 1,000 webers, which would require two horse-power to maintain. This enormous current could be easily maintained provided the contacts could be kept at the low limit of resistance. The amount of metallic copper deposited per hour would be 2·7lbs.; and it would be deposited as a fine reguline mass, judging from the ratio of the current to the unit area of electrode, or in other words, the density of the electrical current. By reducing the distance between the electrodes to 1in., the area could be reduced to 100 square feet, with the same amount and character of deposit. Indeed, the distance between the electrodes could be reduced to ¼ inch and the area to 25 square feet, still maintaining the quantity and reguline character of the deposit; but the distance between the plates would, in the bath, practically be too little to admit of regular working unless the solutions were more than commercially pure. The smallest spicule of matter attaching itself to one of the plates would, if conducting, cause the metal to rapidly accumulate at that point, and this accumulation would have to be removed or the distance of the plates temporarily increased, to prevent contact being established between the plates.

The economy of similar low resistance machines, and their immunity from damage in practice are advantages beyond doubt; but these advantages are more than counterweighted by the care and constant labour incurred at the bath. Besides, it is not only at the bath that difficulties occur; at every contact the slightest oxidation materially reduces the resistance, and for hours the work may be delayed until the bad place is found. Only those who have worked in an atmosphere containing even traces of acid fumes know how quickly a highly (comparatively) resisting film is formed upon copper contacts of large surface. Mercury contacts, although well in theory, are subject to volatilisation by the heat generated by the enormous flow of current, if the slightest accident occur at the mercurial contact to raise the resistance there.



For these reasons much thought and trouble have been given by many inventors to the construction of magneto-electro machines without a commutator. These attempts might be classed under two heads, the unipolar machines we are discussing, and machines in which mechanical devices are employed. And although digressive, it is convenient here to remark that the latter may be said to be all included under the original form described by H. Wilde in his patent No. 842, of 1867. Wilde's device includes bringing the ends of the wires of the revolving coils to two solid rings insulated upon the shaft of the machine, springs or brushes being arranged to carry off the alternating currents to a commutator, separate from the machine, and worked by a belt from the machine shaft. Compared with bipolar dynamo-machines of ordinary construction, such an arrangement only introduces two sets of brushes instead of one, or what must necessarily be two bad contacts instead of one. The advantage, of course, lies in the production, by the bipolar system, of a higher electromotive force. This advantage can, however, be obtained in unipolar machines by a modified construction which will be next described.

(TO BE CONTINUED.)

* Owing partly to the indisposition of the writer, and partly to press of his business in other subjects, and in other countries, the continuity of these articles has been somewhat long interrupted. They will be continued now with notes bringing the matter up to date.—P. H.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 178.)

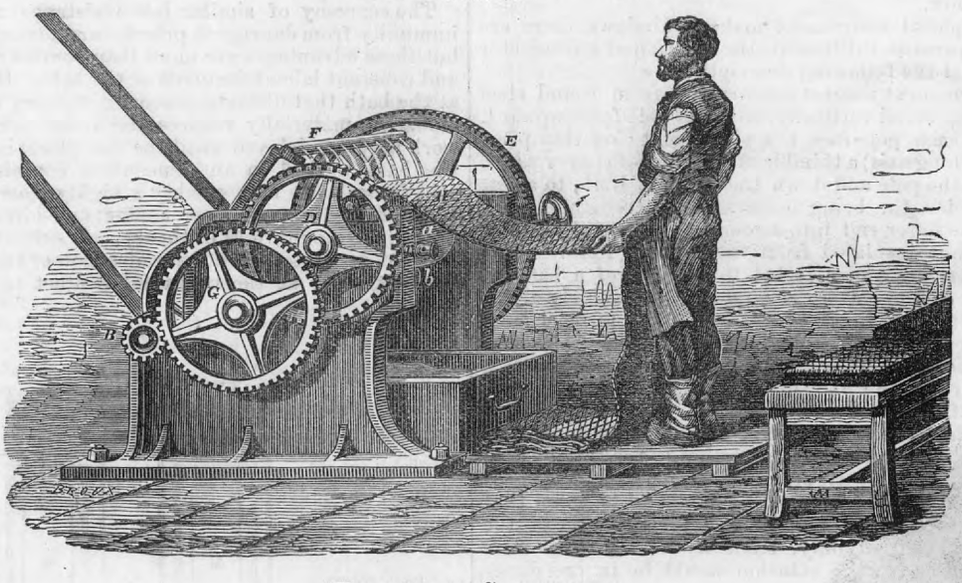
LECTURE II.—DELIVERED FEBRUARY 9, 1880.

Mechanical and Chemical Purification of India Rubber. Working of Unvulcanised Caoutchouc. Formation of Blocks, Sheets, and Threads—Elastic Webbing. Other Uses of Unvulcanised India Rubber.

The first step in the industrial purification of the raw caoutchouc consists in boiling the crude material in water for some hours; and during this process the caoutchouc becomes so far softened that it can be easily cut into slices by means of a knife.

In actual practice, large covered rectangular tanks are employed, steam being injected in order to keep the water at a boiling temperature. The operation is imitated, for the purpose of illustration, by the arrangement you now see on the table. The water in this glass vessel having been kept boiling by means of steam during the last two hours, these lumps of raw caoutchouc are tolerably well softened; and you will notice that the india rubber has become whitish from the absorption of water. This particular lump has most likely absorbed as much as fifteen or sixteen per cent. of water. The softened lumps are next cut up into thickish slices by a long sharp knife, and during this operation the workman throws aside any stones or large particles of foreign matter with which he may meet. A pair of rather large even-speeded rollers are next brought into requisition to crush the slices of softened rubber. These rollers work in the same horizontal plane, or nearly so, and are fluted on the face by a series of deep spiral grooves, diamond shaped projections being left between these. During the crushing of the india rubber, a stream of water is kept running on it, this water being generally hot in the case of the first crushing operation. The first pair of rollers reduces the caoutchouc into the form of a very rough and broken-surfaced sheet, from which many of the mechanical impurities have been removed by the crushing action of the rollers and the rinsing action of the water. The very rough sheet produced, as above described, and of which a sample is before you, is again washed by means of a somewhat similar, but smaller, pair of rollers, cut on the face with a much finer diamond-shaped pattern, and this washing is continued until all mechanical impurities are worked and washed out of the rubber. Here are some samples of "washed sheet," and you will notice the peculiar broken surface which it presents, while by looking at it in certain lights you will be able to trace out the diagonal pattern imprinted by the rollers. The engraving which I now project on the screen will give you some notion of the operation of washing india rubber on a large scale (Fig. 7), and I will now show you a diagram illustrating the manner in which the surface of a washing roller is cut (Fig. 8). The cuts are made from ¼th to 1-20th of an inch apart, according to circumstances.

FIG. 7.



WASHING OF CAOUTCHOUC.

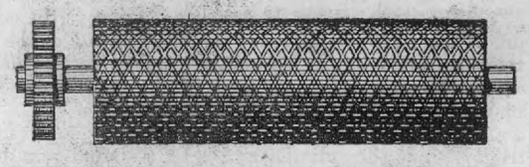
The next thing is to illustrate practically to you the operation of washing. Here is a pair of fluted rollers, and on passing some of the slices of softened rubber through them a few times, you see that the impurities are washed away by the stream of warm water flowing from above, and the rubber is agglomerated into a rough, irregular sheet, which I will pass round for your inspection.

The completeness with which solid impurities are removed from caoutchouc by the operation of washing is, at first sight, surprising; but it must be remembered that, as soon as the tearing action of the rollers enables water to penetrate between any foreign body and the india-rubber, this body is in a fair way to be carried off by the stream of water. The rubber, as it leaves the washing rollers, contains a considerable amount of water locked up in its pores, and in order to remove this, the washed sheet is taken to a stove or drying room, where it is hung up until all moisture has evaporated. A considerable loss occurs during the operation of converting the crude india rubber into washed sheet, this loss occasionally amounting to over one-third of the original weight of the material; and the following table, which is extracted from a series of excellent articles on india rubber and gutta percha, which have recently appeared in the *Universal Engineer*, will give some notion as to the average loss which various qualities of caoutchouc are subject to:—

QUALITY OF CAOUTCHOUC.*	Loss by Washing.
Para	15 per cent.
Negrohead	25 ,,
Guayaquil	40 ,,
Borneo	25 ,,
Ceara	28 ,,
African Ball	25 ,,
African Nigers	25 ,,
Madagascar	25 ,,
African Tongue	35 ,,

The washed sheets of india rubber, considered as sheets, are of no practical utility, for they are irregular, and full of perforations, but the washed sheet rubber is the starting point as regards most of the further developments of the rubber industry. By the operation of mastication, the washed sheets are worked up into compact homogenous masses. The masticating machine invented by Thomas Hancock consists of an internal cylinder of metal, which revolves in a cylindrical iron casing. The india rubber to be masticated, being placed between the rotating cylinder and the outer casing, becomes subjected to a powerful mixing and grinding action, which ultimately reduces the india rubber to a long solid lump, something like a sausage. Here is a model (Fig. 9) intended to illustrate the action of the masticating machine; and if I introduce a little washed sheet india rubber, previously softened by a gentle warmth, and get Mr. Barker to turn the handle, you will soon see that it is reduced to a compact form by the continual rolling and kneading action of the machine.

FIG. 8.



ROLLER OF WASHING MACHINE.

The masticating machines employed in actual practice are large and heavy, being often capable of working as much as 200lbs. of caoutchouc at a time. The diagram now shown on the screen (Fig. 10) represents the masticating machine as constructed at the present time, but the upper quadrant of the outer casing, which is represented as being open, is, during the working of the machine, partially or completely closed by a series of curved iron plates or doors, which can be clamped down

* Reprinted by permission from the *Journal of the Society of Arts*.

* L'ingenieur Universal: The Universal Engineer. Diglot Journal, Manchester, 14, Oxford-road. Vol. II., page 187.

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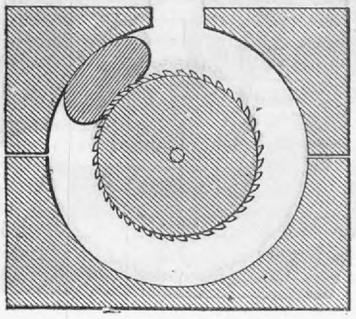
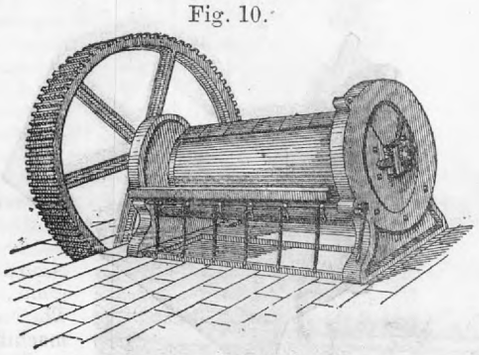
into position by the levers shown at the lower part of the diagrams. The weight of these doors or traps is balanced by a series of counterpoises, so that the apparatus can be opened with facility. The central cylinder is fluted, so that its section would represent the appearance of a circular saw (Fig. 10), and water-way passes through it axially, so that the great heat produced during the mastication of the india-rubber may be moderated by a stream of cold water.

Fig. 9.



Section of Model used to Illustrate the Action of Masticating Machine.

Fig. 10.



The Masticating Machine.

During the progress of the operation of mastication, which may last from four to five hours, the sausage-like block is occasionally cut in half, and the pieces are replaced in the machine in a reversed direction. Here is a piece of one of the masticated blocks, and if you examine this section of it you will see how very uniform the texture of the material has been rendered by the operation of mastication. The masticated rubber is generally converted into rectangular blocks by being forced into iron boxes, it being previously softened by subjection to the heat of steam at a moderate pressure. When thoroughly cold and set, the blocks are removed from the iron moulds. The rectangular blocks thus obtained are largely employed for the manufacture of the "fine-cut sheets," which sheets are extensively used in the fabrication of various small articles of caoutchouc. In order to cut these blocks into sheets, the block to be operated upon is fitted into a box attached to a sliding arrangement, like the bed of a planing machine. As the block is led forward by the mechanism, a slice is taken off by a sharp knife, which moves to and fro at the rate of two thousand movements per minute, this knife being kept wet by means of a stream of water. The outer sheet having been cut off, the block is raised in its box to an extent corresponding to the required thickness, and the operation of cutting is then again performed; the raising and cutting being now repeated until the whole of the block has been divided into sheets. The feed of the block up to the knife is generally at the rate of about one inch for each 60 cut, as one may perceive by counting the ribs on an ordinary piece of cut-sheet rubber. Occasionally, sheets are cut from cylindrical blocks, the block being made to revolve slowly on a kind of lathe, while a rapidly moving knife, attached to a rest, cuts the cylinder into one continuous sheet; but the method in question does not appear to find much favour in this country.

On the table you will find a very complete collection of specimens illustrative of the processes I have alluded to, these having been kindly lent by the Silvertown Company, Mr. Bell, Messrs. Tuck and Co., Messrs. Anderson, Abbott, and Anderson, and others. In the case of these coloured cut sheets, pigments are incorporated with the caoutchouc. The pigments are best incorporated by means of the mixing rollers, which will be described in the next lecture, the coloured rubbers being then masticated; but the masticating machines may be used for the incorporation of solid matters with the caoutchouc.

During mastication, the india rubber undergoes a remarkable deterioration or degeneration, especially as regards its fibrous or insoluble constituent. India rubber during a thorough mastication loses much of its elasticity and strength, and either dissolves perfectly in cold naphtha, or forms something which is remarkably like a true solution. To illustrate the difference in this respect, between unmasticated rubber and that which has been masticated, I will put a slice of raw Para rubber and a similar slice of masticated Para rubber side by side in a bottle of coal naphtha. The former will swell, but retain its form, while the latter will dissolve in the course of a few days.* This kind of deterioration, due to masticating, renders the rubber eminently fit for the manufacture of the solutions or pastes employed in making waterproof textures, or for other purposes, and the superior qualities of masticated rubber for the preparation of solution were fully recognised by Hancock when the rubber industry was in its infancy. Although mastication alters the fibrous or insoluble constituent in such a way as to make it approximate in its nature to the soft or viscous constituent, there is always a notable distinction between the properties of a high quality of rubber, altered by prolonged mastication, and a low class rubber such as African tongue.

Threads for elastic webbing were formerly cut from blocks of unvulcanised rubber, or even from the raw Para caoutchouc itself, this latter course being adopted in order to avoid the deterioration due to working or mastication. In the present day, however, vulcanised india rubber is almost exclusively employed for the manufacture of threads intended for use in making elastic webbing. Notwithstanding this, what little I have to say regarding the cutting of threads I will say now, as the manipulatory details are not affected by the vulcanisation or non-vulcanisation of the rubber. Much ingenuity and skill has been expended on machines for cutting india rubber into threads, and several systems have been employed. Sometimes, for example, a tube is converted into a single length of thread by one spiral cut, and in other cases a long sheet or strip is divided into a number of threads by means of a set of revolving knives. Here is such a set of knives, and I will first illustrate their action to you by cutting up a strip of sheet rubber, and then I will hand round the set of knives for your inspection. The sheets from which threads are cut are usually spread sheets, the nature of which will be explained in a future lecture, although calendered or rolled sheets are sometimes employed. The excess of the sulphur employed in vulcanising the rubber is generally removed by boiling the threads in a 6½ per cent. solution of caustic soda for a period varying from quarter of an hour to one hour.

On the table you will find a selection of threads and of webbing manufactured from them, some of these threads being so fine that eight thousand yards only weigh one pound.

India rubber threads have some industrial uses of interest, apart from their employment in the manufacture of elastic webbing. They are, for example, employed instead of weights in the Jacquard loom, as many as three thousand being occasionally used in one of these marvellous pieces of mechanism.

Here is a pretty little toy, depending for its action on a wound-up spring formed of a thread of caoutchouc. When released, this spring actuates two vanes, arranged like the blades of a screw propeller, and away the thing flies right over your heads, and it continues to fly about until the force stored up in the spring becomes exhausted. Perhaps we may have the germ of a flying machine.

Later on in the course I shall have occasion to refer to the production of india rubber threads by the process of squirting, this mode of procedure consisting of the forcing of softened caoutchouc through a die or hole.

A very large number of small articles, such as surgical goods, tobacco pouches, tubes, and so forth, are manufactured from the cut sheet rubber, and on the table you will find a considerable assortment of such articles which have been lent by the firms previously mentioned.

The manufacture of such articles of cut sheet can best be illustrated for lecture purposes by a demonstration of the process of making the air balloons which are such favourite toys with children, and which are also extensively employed, especially in Paris, for advertising purposes. Mr. Dugwell, of New-road East, has kindly brought me a very extensive selection of these balloons, and of the appliances used in their manufacture; while Messrs. Anderson, Abbott, and Anderson, of Queen Vic-

* At the following lecture the bottle was shown. The raw rubber was intact, while the masticated sample had dissolved, with the exception of some traces of flocculent matter.

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toria-street, have provided me with some india rubber balloons of an unusually large size.

Here, then, are some pieces of cut sheet rubber, and I will rub some French chalk on one side of each sheet. The next step is to arrange the sheets in pairs, the chalked surfaces being placed together in each case. In the next place, the outer surfaces of each pair are moistened with water, and the pairs are piled up together like the sheets of a quire of paper, eight pairs being super-imposed in the present case. Here, then, is a steel punch capable of cutting out a pear-shaped piece corresponding to the uninflated balloon, and you see that I now punch pieces out of the pile of sheets. The moistened surfaces readily separate from each other, and the result is a number of pear-shaped pieces of rubber, each of these being formed of two sheets, French chalked over the surfaces, which are in contact, and slightly adherent round the newly-cut edges. In the next place the sheets are separated at the part corresponding to the neck of the balloon. At this stage the uninflated air-ball may be considered to have had its first form given to it, but the newly-cut edges are very imperfectly adherent, only the extreme and inner angles of these being in contact; the major portion of the newly-cut surfaces being exposed to view round the edges of the punched-out pieces. A rather thin solution of india-rubber in benzole is now painted around these raw edges in order to make them more adhesive, after which the centres of each of the two pieces of sheet rubber composing the balloon are pulled out by the finger and thumb of either hand. This operation brings the adhesive edges of the balloon into perfect contact; they adhere, and the balloon is finished as far as constructon is concerned. It is, however, usual to slightly vulcanise articles which have been manufactured from the cut sheet rubber, in order not only to give them increased elasticity and strength, but also to protect them against the influence of cold, heat, grease, &c. Several methods of vulcanisation are available for this purpose, and these will be discussed in the next lecture, but for the present I will just show you how the balloon can be vulcanised by a momentary immersion in bisulphide of carbon, containing a very small proportion of protochloride of sulphur, one-fourth of a per cent. being sufficient for this purpose, although two and a half per cent. is a usual proportion for general work. The above is the well-known cold-curing process introduced by Parker. After dipping, the balloons are dried by a gentle heat on a tray covered with French chalk. They are now ready for inflation, and you see that Mr. Dugwell is busily engaged in the operation of inflating a number of those balloons which he has brought with him, and he intends to give each one of you an opportunity of taking away one of them.

The manufacture of other articles out of unvulcanised cut sheet is so analogous to the making of the air balls, that I need not specially illustrate the processes; but I may mention, that although these articles are generally vulcanised by the cold process after they are made, the vulcanising action is principally confined to the surface, so that these partially vulcanised articles are more or less liable to become rigid by the action of cold.

Solutions of india rubber have very many important uses, and they may vary in consistency from stiff pastes to limpid fluids, according to the proportion of rubber, its condition, and the nature of the solvent employed. A pasty solution or dough, containing about 20 per cent. of masticated rubber, dissolved in or incorporated with benzole or coal naphtha, is used in the industrial arts for a variety of purposes. It is employed extensively as a cementing material, and answers very well as a mounting medium for photographs, or for the repair of certain articles of india rubber, while a textile fabric can be rapidly and easily rendered waterproof by being imbued with this substance. Such a paste or solution is usually prepared by allowing the rubber to swell in the benzole or solvent, and then kneading the product by means of a suitable machine. A very excellent apparatus for this purpose is the kneading and mixing machine invented by Mr. Pfleiderer. One of these ingenious machines is in action on the table, and by its side is a set of the variously formed mixers which are sent with the apparatus (Figs. 11, 12, 13, 14).

By the evaporation of a solution of india rubber in such a solvent as carbon disulphide or chloroform, a very delicate and pure film of caoutchouc may be obtained; and here is such a sheet of rubber, prepared by allowing the solution to dry on a levelled glass plate. Mr. Forster, of Messrs. Cow and Co., has utilised this principle in the production of india rubber gloves, of extreme tenuity and uniformity of thickness. These gloves are formed by repeatedly dipping a kind of last, or mould, into a solution of rubber, and vulcanising the film left on drying, by means of the cold process. By repeated operations, any required thickness of rubber can be built up. These gloves, some pairs of which I will hand round for inspection, are so thin, that a surgeon may wear them while performing an operation, in order to protect himself from possible blood poisoning; or a photographer may employ them to prevent the staining of his hands by the salts of silver which he employs.

FIG. 11.

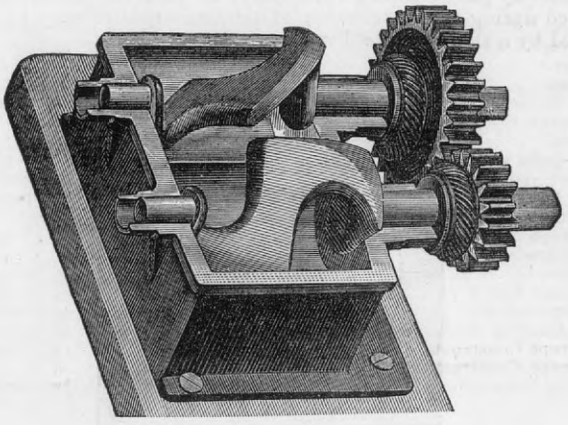


FIG. 12.

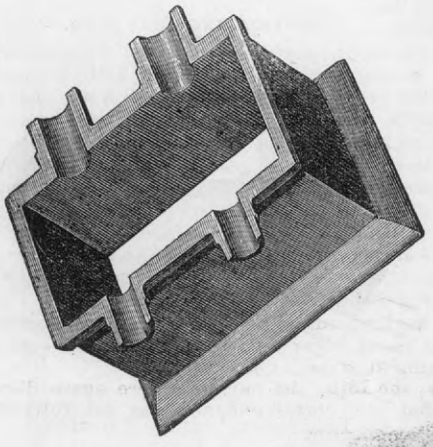
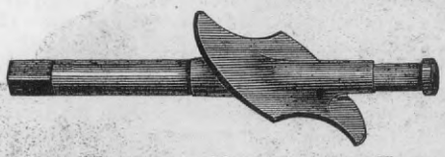


FIG. 13.

FIG. 14.



PFLEIDERER'S KNEADING MACHINE AND EXAMPLES OF THE VARIOUS MIXTURES.

Unvulcanised caoutchouc is employed in the fabrication of the valuable cement known as marine glue, this being made by melting together one part of india rubber, previously softened by, or dissolved in coal naphtha, and two parts of shellac.

(TO BE CONTINUED.)

CORRESPONDENCE.

EARTH CURRENTS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: I read with much interest the correspondence in your journal about the earth currents of the 11th, 12th, and 13th of this month, and believing it might be of interest to you to hear a

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Stationed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,321	220	A. Hyde	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	Vigo.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Silvertown.
Telegraph Construction	ss Edinburgh	2,330	275	Seymour	East Greenwich.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	Killett	East Greenwich.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	ss Pouyier Quertier	1,385	160	Maypee	——
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Syra.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	Cato	London.
Telegraph Construction	ss Seine	3,579	500	Manning	London.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.

little of how they appeared to us, I hereby have the pleasure to communicate to you the following:—

On the 11th we had disturbances from 11 a.m. till late in the night, but no aurora visible. On the 12th the current began disturbing our German cable at about 9 a.m., and at 11 a.m. it was impossible to work any line. At 12:30 p.m. the current reached its maximum strength. I had no time to measure it, but it was so strong that in one of the keys where the battery wire was taken away and the key depressed, the current passed over in a lighting arch between the lever and the back stop, and began to burn the platinum, so that it was found necessary to ground this and all other lines in half an hour.

The lines running north and south were more disturbed than those running east and west. First, at 5 p.m., it was possible to commence working one or two lines, and the current quite disappeared at about 8:30 p.m. This day we had a splendid aurora in the evening at about 11:30.

Saturday, the 13th, the currents were again disturbed some hours, so that our correspondence was not fully cleared away before Sunday morning.

We sometimes use under such circumstances the "American" closed circuit with or without battery—without battery when the current is not strong enough or is too much varying to produce readable signals.

This system works often very well, and was used with success in some lines under the disturbances.—Yours, &c.,

JOHKJENNERUD.

Christiania, Aug. 26.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).

The forty-sixth ordinary general meeting of the shareholders of this company was held at the City Terminus Hotel, Cannon-street, on Thursday, the 2nd inst., under the presidency of Sir James Carmichael, Bart., chairman of the board of directors.

The SECRETARY (Mr. Edward Tombs) read the notice convening the meeting, and the report of the directors for the half year ended the 30th June was taken as read. It stated that the half-yearly balance sheet of the company showed a claim under the guarantee of £3,107, while there had been a slight diminution in the receipts. It having been ascertained by the Treasury that payments to the amount of £1,185 had in former years been paid in excess of its actual liabilities under the guarantee, the department had deducted such sum from the amount now claimed, less £707 erroneously deducted from the last payment, as shown in the balance sheet. These amounts would be respectively debited and credited to the reserve fund. They regretted to report the death of Captain Hamilton, an old and much-esteemed colleague, who had formerly rendered valuable services to the company. The directors recommended the payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the Preference Stock of the company, and of 3 per cent. per annum, free of income-tax, on the Ordinary Stock of the Company, payable on and after the 7th inst., leaving £462 to be carried to reserve. The revenue account showed that the receipts for messages during the half year had been £2,036, the expenses were £1,593, leaving net receipts £442 and the amount required to make up a minimum surplus for appropriation of £3,600.

The CHAIRMAN, in moving the adoption of the report, said that the slight delay that had taken place in holding the meeting had arisen from their anxiety before they did meet to have a complete and thorough settlement with the Treasury of the points in dispute. He was happy to say now that the whole of the difference had been amicably arranged, and the result was that while they had insisted on the old claim of £1,185, which no doubt was due to them—for a government could claim a debt at any time—and which they had paid this company in error in years past, they had, on the other hand, agreed to waive the claim they made against the company last year of £707. Putting one against the other, the result would be that they would eventually pay the Government £477. He was very glad that the whole thing had been settled, and settled without serious loss to the company, and he thought the accounts had now been put on such a footing as between the Government and themselves that no dispute could ever arise again. The only other matter he had to call attention to was the death of their lamented friend and colleague, Captain Hamilton, who was well known in the telegraph world. He was one of the earliest directors of the Anglo-American Telegraph Company, and he assisted the company in years past in its negotiations with the Italian Government. He was a very valuable director. Mr. Charles Horace Robinson, one of the company's auditors, was a candidate to replace him.

Mr. WHITBY having seconded the motion,

Mr. FUTCHER said that he noticed no item in the revenue account for transfer fees.

The CHAIRMAN said they did not appear as a separate item.

The SECRETARY observed that they were included in the revenue.

Mr. FUTCHER said that in other companies he belonged to they always had transfer fees—for instance, the Eastern and the Globe Telegraph Companies had.

The SECRETARY said they had such an item in their books, which he would be glad to show the hon. proprietor.

The CHAIRMAN thought that in many companies the custom differed. Many telegraph companies did not show the transfer fees.

Mr. FUTCHER said that the chairman of the Globe Company (Mr. John Pender, M.P.) at one of the meetings noticed the amount of the transfer fees, as showing how the company was progressing.

The CHAIRMAN said such an item might show the amount of speculation on the shares. It would only put another item in their accounts, and it was a very small item with them.—[The report was then unanimously adopted.]—Continuing, the Chairman moved the payment of the dividends, in accordance with the recommendation in the report.

The Hon. A. PONSONBY seconded the motion, and it was carried unanimously.

On the motion of Mr. T. ADAMS, seconded by Mr. WHITBY, the retiring directors, Sir James Carmichael, Bart., and the Hon. Ashley Ponsonby, were re-elected to their seats at the board.

The CHAIRMAN briefly acknowledged the compliment, and moved the election as a director of Mr. C. H. Robinson.

Mr. T. ADAMS seconded the motion, and stated that as a director of another company he had known Mr. Robinson for many years as the auditor of that company. He was sure they would have the faithful services of that gentleman.

The motion was carried unanimously.

Mr. ROBINSON expressed his acknowledgments, and referring to his constant attendance at the meetings of the company, said they knew that his feeling as regarded the company was to see it restored to the position it occupied a few years ago. His view was that they should so act that at the termination of the concession they might, at any rate, realise some small dividend from some other company, which he entertained the hope of being allied with. He wished the shareholders would take the matter in hand, and see if anything could be done to enhance the value of the property.

On the motion of Mr. WHITBY, seconded by Mr. FUTCHER, the retiring auditor, Mr. Allwright, was re-elected; and on the motion of Mr. ROBINSON, seconded by Mr. FULCHER, Mr. Hayward was elected the other auditor of the company to fill the vacancy caused by the election as a director of Mr. Robinson.

A vote of thanks to the chairman and directors was then passed, on the motion of Mr. Adams, and

The CHAIRMAN having briefly acknowledged the compliment, regretting that the meeting was not more largely attended, the proceedings terminated.

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 1.		Business Done Week Ending Sept. 1. Highest.		Lowest.	
Anglo-American Ordinary	65½,	66	66⅝		65¼	
Do. "B"	96¾,	97¼	97⅜		96⅝	
Do. "A"	36½,	37	37¼		36¼	
Brazilian	9 1-16,	3-16	9⅜		9	
Cuba	9½,	¾	9⅝		9⅜	
Do. Ten per Cent. Pref.	16½,	17	16¾		16½	
Direct Spanish	1¾,	2¼	—		—	
Do. Ten per Cent. Preference	11½,	12	12⅛		11⅞	
Direct United States	12⅜,	⅝	12¾		12⅜	
Eastern	9 13-16,	15-16	10		9 13-16	
Do. Six per Cent. Debenture	106,	108	—		—	
Do. Five per Ct. do. 1899	103,	106	—		—	
Do. Six p Ct. Pref.	12¾,	13	12⅞		12¾	
Eastern Extension	9⅞,	10	10		9 15-16	
Do. Six per Ct. Deb	106,	108	107½		107¼	
German Union	9,	½	9½		9⅜	
Globe Telegraph & Trust	6 13-16,	15-16	7		6¾	
Do. Six p Ct. Preference	12⅜,	½	12½		12⅜	
Great Northern	9⅞,	10⅛	10⅛		9¾	
Indo-European	24½,	25½	—		—	
Mediterranean Extension	2¾,	3¼	3 3-16		3	
Do. Eight per Cent. Preference	10¾,	11½	—		—	
Reuter's	9½,	10½	—		—	
Submarine	242,	248	245		243	
West India and Panama	1 9-16,	11-16	1⅝		1 9-16	
Do. Six per Cent. 1st Preference	7⅛,	⅞	7 15-16		7¾	
Western and Brazilian	7 1-16,	3-16	7¼		7	
West. Union 7 p. Ct. 1st Mt.	120,	125	—		—	
Do. Six per Ct. Sterg. x d. Sept. 1	102,	104	105½		105	

TRAFFIC RECEIPTS FOR AUGUST, 1880.

Companies.	Aug., 1880.	Aug., 1879.	Incrse.	Decrse.
Cuba Submarine Company	—	—	—	—
Direct Spanish Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,988	36,257	6,731	—
Eastern Extension Telegraph Company	30,249	26,242	4,007	—
Great Northern Telegraph Company	—	—	—	—

ADDRESSES.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY
(Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia
Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53,
COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works,
IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39,
COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER
WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

ALEXANDRA PALACE.

LIGHT EXHIBITION AND MART,
SEPTEMBER 27th to OCTOBER 9th, 1880.
ENTRIES CLOSE SEPTEMBER 20th.

SECTION A.

CLASS 1. Motors suitable for Driving Dynamo Machines.
,, 2. Dynamo-Electric Machines.
,, 3. Electric Lamps and Carbons.
,, 4. Photometers especially applicable to Electric Light Measurement.
,, 5. Miscellaneous Electrical Apparatus for Sale.

SECTION B.

CLASS 1. Gas Apparatus, including Portable Gas Works, Fittings, Burners, &c.
,, 2. Candles of all kinds.
,, 3. Petroleum and Oil Lamps, and all applications of Petroleum and Oil to Lighting purposes.
,, 4. Miscellaneous Apparatus, not included in any of the above, as Gas Stoves, Oil Stoves, Reflectors, &c.

For Forms of Entry, &c., apply to
Mr. G. GROUT, Alexandra Palace, N.

TO ELECTRIC LIGHTING COMPANIES and Others.

The STREETS COMMITTEE of the COMMISSIONERS of SEWERS of the CITY of LONDON will meet in the GUILDHALL of the said City on FRIDAY, the 10th September, 1880, at 2 o'clock precisely, to receive TENDERS for LIGHTING by means of the ELECTRIC LIGHT, as an experiment—

New Bridge Street,
Queen Victoria Street,
Queen Street Place and Queen Street,
King William Street,
Poultry,
Cheapside,
St. Paul's Churchyard (North Side).
Ludgate Hill,
Blackfriars Bridge,
Southwark Bridge,
London Bridge,

Agreeably to printed conditions to be obtained at this office on payment of two guineas (which will be returned upon a *bonâ fide* tender being sent in).
The tenders are to be on the forms to be had here on application, and are to state the terms for six months and also for twelve months, from the 1st of November next, burning from sunset to sunrise, also from sunset to midnight.
The tenders must be sealed, endorsed "Tender for Electric Lighting," be addressed to the undersigned, and delivered at this office before 2 o'clock on the said 10th of September.
Parties making proposals must attend personally, or by a duly authorised agent, at 2 o'clock on the said day.
The Commissioners do not pledge themselves to accept the lowest or any tender.

HENRY BLAKE, Principal Clerk.
Sewers' Office, Guildhall, 16th August, 1880.

NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

ELECTRICAL AND SCIENTIFIC APPARATUS.—WHOLESALE MANUFACTURERS OF ELECTRIC BELLS, ELECTRIC REVERSING INDICATORS, and CONSTANT MANGANESE BATTERIES. Telephone Switches and Transmitters, Induction Coils and Vacuum Tubes, Terminals, Carbons, Wire, and all materials. Instruments made, repaired, or altered on the Premises. Illustrated Bell list free. Complete catalogue two stamps. Special quotations to the trade.—DALE and CRAMPTON, Manufacturing Electricians, 4, Little Britain, London, E.C.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby.

THE "JAMIN" PATENT ELECTRIC LIGHT.
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

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SLIP

PERSONAL.—Lieut. H. L. Wells, R.E., has been appointed Assistant Director, Persian Telegraph Department.

THE NEW CABLE COMPANY.—It is rumoured that this company has negotiated a Portuguese concession for another cable from England to the Azores, thence to America.

M. SERRIN.—We are glad to observe that the inventor of the well-known regulator-lamp, which for the last twenty years has rendered service in electric lighting, has received the decoration of the *Légion d'honneur*.

THE IMPERIAL YACHT LIVADIA.—The system of distinguishing red, white, and green electric lights in this splendid vessel has been worked out under the guidance of his Imperial Highness the Grand Duke Constantine.

BARCELONA.—Experiments in connection with the system of electric lighting adopted by Messrs. Molera and Cebrian are deferred on account of alleged defects in instruments received from Paris. Mr. Cebrian is leaving for San Francisco.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY.—This company has received notice from the West Coast of South America that telegraphic communication has been re-established with Iquique.—It is announced that Mr. Sam Mendel has resigned his seat at the Board.

THE NEW NORTHERN CABLE.—The ss. "Edinburgh," belonging to the Telegraph Construction and Maintenance Company, left Greenwich on Tuesday with a portion of the new cable, and was followed on Thursday by the ss. "Kangaroo" with the remaining portion of this cable.

TELEGRAPHS IN ASIATIC TURKEY.—Writing from Trebizond, the British Consul in his report says:—"Telegraph and post offices continue to be fairly managed, but the latter have not yet been extended to the Persian frontier towards Bayazid, as it was rumoured they would be a year ago."

CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this Company during the month of August was 1,808, estimated to produce £2,000, against 2,211 messages, producing £2,557 in the corresponding month of last year. The traffic receipts for the month of June, estimated at £2,700, realised £3,147.

PORTSMOUTH DOCKYARD.—On Tuesday the Lords Commissioners of the Admiralty began their official inspection, and after visiting the "Inflexible," they were taken to the adjoining electric shop. Here they saw the electric light, and witnessed the operation of electro-plating, and examined an ingenious piece of apparatus for numbering the revolutions of machinery by an electric contact.

MONTREAL.—The Harbour Commissioners have purchased the electric light, which has been on trial there during the past two months, at the original cost price, which is said to be about 6,000 dollars, including a new engine, and additional number of lights. Now that the days are gradually becoming shorter, the advantage of the improved light will be all the more appreciated by those engaged in loading and unloading steamships.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).—In consequence of the unusually numerous interruptions to their cables, their ship permanently stationed in the West Indies has been unable to overtake the repairs, and the directors have consequently found it necessary to send out a second vessel to assist. The new ship will sail in a few weeks, on the completion of the necessary alterations and fittings, and will take out with her a further supply of new sheathed cable.

THE SIEMENS LAMP.—A number of these electric lamps are used to illuminate the fine station of the Bergish-Merkish Railway at Düsseldorf. Lamps are also erected for illuminating the Exhibition, and several of the works visited by the members of the Iron and Steel Institute during the late meeting at Düsseldorf have partially adopted the electric light as an illuminant in their shops. It may also be mentioned that the light has been introduced into some parts of the immense works of Fried. Krupp at Essen.

SOMETHING LIKE A MISTAKE.—In the celebrated "Preliminary Discourse on the Study of Natural Philosophy," which forms one of the volumes in Lardner's "Cabinet Cyclopædia," it is stated that "All the phenomena of magnetic polarity, attraction, and repulsion have at length been resolved into one general fact, that two currents of electricity, moving in the same direction repel, and in contrary directions attract, each other." As most of our readers are already aware, the words "repel" and "attract" should here change places.

INSULATION OF WIRE.—As is well known, several suggestions have been made and tried with more or less success for insulating wire with substances that are easily liquified, and can be poured into a tube containing the wire to be insulated. Messrs. Manly and Philips, of Philadelphia, point out that the ordinary process of pouring the insulating material into the top of the tube possesses several disadvantages which they decide will be overcome by forcing the substance from the bottom, and have patented an apparatus to do this work.

CURIOUS FREAK OF LIGHTNING.—*Le Petit Marseillais* is answerable for the following:—"St. Etienne, Aug. 23. Last Thursday, during a violent storm, a young man was walking along the Richelaudière road, having in his hand a carriage lamp, unlighted. Suddenly he experienced the sensation of a violent shock in his arm, and concluded that the lightning had either struck him or fallen close to him. But what was his astonishment to find that his lamp had been lighted! Several persons who were behind him on the road observed this curious phenomenon."

SWAN'S LAMP.—At the time Mr. Edison brought out his lamp, it was stated that Mr. Swan of Newcastle had long ago tried a similar plan, and found it a failure. He states, however, that he has now succeeded in devising a plan to keep the incandescent matter intact. It is to exhaust the containing vessel to a high degree, at the same time raising the carbon to as high or a higher temperature if possible than it is likely hereafter to be subjected. Whilst in this incandescent state the exhausted containing vessel is hermetically sealed. This operation is said to obviate the failure of the carbon by disintegration.

BURTON-ON-TRENT.—Messrs. Bass and Co. have introduced the electric light into their extensive premises at Burton-on-Trent. There are at present twenty-one lights, worked by a Brush dynamo-machine, the whole supplied by the Anglo-American Electric Light Company. The machine is driven by a 10 horse-power portable engine. Two rooms—the cask office and the square room—are fully lighted by electric lights, whilst other parts are only partially lighted. Hitherto the cask room has been lighted by thirty-five gas lights, and these are replaced by two electric lamps. Mr. Bass is reported to be fully satisfied with the experiment.

ELECTRIC LAMPS.—Mr. Patrick Drew, of Brooklyn, has patented what he considers to be an improvement in the Edison lamp. He constructs his vacuum chamber and sealing tubes in such a manner that the tube is closed round the wire at the point least subject to expansion and contraction, and arranges that at the point of maximum expansion and

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contraction the wire is practically free without affecting the glass. Mr. Drew evidently does not understand the difficulties to be overcome before a vacuum lamp will become commercially possible. Let him devise a non-disintegrating material for the burner, and then perhaps his plans may be thoroughly considered.

Delay in Continental Telegrams.—A correspondent who has just returned from the Continent writes us as follows:—"The International Telegraph Convention is supposed to have done a great deal to advance telegraphy. It, however, does not appear to have done much for accelerating the despatch of telegrams between the Continent and England, as the two following instances of slow transmission will testify. A telegram handed in at the Bourse station in Paris on the 24th inst. at 6:45 p.m. did not arrive at the Submarine Company's station in London until 9:40 p.m., thus occupying two hours and 50 minutes in transmission. Another message handed in at Neuhausen (Suisse) on the 27th inst., at 1 p.m., was only received at the Submarine Company's station in London at 6:14 p.m., having occupied five hours and 14 minutes in transmission." This does not compare well with the rate of transmission of messages to and from America by our Atlantic Cable Companies.

At Manchester.—It is not at all times right to tell secrets out of school, but this is a real case of induction. A number of gentlemen were the other day about to dine, and one of the covered dishes was especially cared for, containing it was seriously averred a "gymnotus," fresh from the rivers of South America, which was to form part of the repast. Usually electricians scrupulously observe decorum, but the chairman, instead of pronouncing the benediction, turned to the dish containing the eel, and solemnly requested grace, when, with a sweet cadence, as if from a mermaid in cavernous regions, was heard all over the room:—"Be present at our table, Lord," &c. The cover was then raised, and the anticipated electric eel turned out to be a telephone, which had been ingeniously connected to a distant room, and which being a religiously good telephone, not only produced a pleasing sensation to all present, but afterwards returned thanks in a powerful but well-known voice to the admiring listeners.

A Telegraph Scheme.—The *Montreal Witness* says:—"A vast telegraph scheme, which in this age it would be folly to decry as impracticable, is mooted, Mr. F. N. Gisborne, Superintendent of the Dominion Telegraph Signal Service, being mentioned as the author. It is no less than to connect America with Asia and Europe, under British auspices, by a system of which a line from the Atlantic to the Pacific, through Canada, is to form a part. To effect the portion of the scheme, a line from Edmontion, North-west Territory, to Cache Creek, British Columbia, remains to be built. A cable from Vancouver Island to the Aleutian Islands will constitute the major portion of the connection with Asia, a few minor links remaining to complete an electric girdle around the earth, with Britain's hands on the buckle. A cable from Japan to Australia, by way of the Kurile Islands, is a supplemental part of Mr. Gisborne's scheme, of great moment to imperial interests. The consummation of the entire project would give the Imperial Government facilities for instantaneous communication with the principal possessions of the empire, which would be a boon of incalculable value to a power that stands unique in the extent and remoteness, from herself and from each other, of her colonies."

A New Voltaic Condenser.—The action of secondary piles, such as those devised by Planté, is very energetic for a short time, but not lasting. An attempt was, therefore, made to discover the causes which limit the condensing power of the lead-plate couple, and, if possible, to rectify them. The gaseous state of the oxidisable metal (hydrogen) unquestionably limits the action, and this soon attains a maximum, which it is impossible to exceed, the lead plate becoming covered with a layer of dioxide which protects the metal from further oxidation. A cell was, therefore, devised in which a zinc plate was used in connection with a carbon one, the latter being surrounded with very fine leaden shot (dust shot), in order to increase enormously the surface of the lead, and the whole was excited with a solution of zinc sulphate. On passing a current from the carbon to the zinc through a couple thus constructed the zinc salt is decomposed, and the metal deposited on the zinc plate, the oxygen forms lead dioxide, whilst the sulphuric acid remains free; the deposit of oxidisable metal is thus unlimited, and the oxygen can be accumulated in very large quantity. With a couple containing only 1 kilo. of shot, the author succeeding in working a Deprez electro-motor for four hours. In practice the zinc plate may be replaced by a mercury pole; the electromotive force of such a couple was be 2·1 volts. The lead plate also may be replaced by several other substances, but nothing else seemed to give such satisfactory results.—*Chem. Soc. Jnl.*

The Gilchrist Engineering Scholarships.—These scholarships, viz.: an entrance scholarship of the value of £35 per annum, tenable for two years, and a senior scholarship of the value of £80, will this year be awarded, for the first time, in connection with the engineering department of University College. In the present year two scholarships of the former class are offered. In regard to these entrance scholarships, the regulations (copies of which, and of the prospectuses of the college classes may be had on application to the secretary of the college, in Gower-street) limit the competition to those who have not previously been students of the college. Candidates will be called upon to show, to the satisfaction of the council, that they were not more than 18 years of age on the 1st of Oct. immediately succeeding the examination. Written notice of the intention to compete, stating whether candidates intend to present themselves for examination in French or German, must be sent to the secretary, together with certificates of age and good conduct, on or before the 23rd September in each year. The examination will this year be held on the 28th September and following days. Every candidate for an entrance scholarship must also declare in writing his *bonâ fide* intention of taking at least the two first years of one of the engineering courses as set forth in the above-mentioned prospectus. In regard to the senior scholarships, candidates must have attended, during the whole of the session immediately preceding the award, college classes in applied mathematics, practical physics, junior engineering, engineering drawing and geology. The senior scholarship will be awarded on the results of the ordinary class examinations in these subjects.

Measuring Currents from Dynamo-electric Machines.—The *Journal Télégraphique* observes that the measurement of the powerful currents generated by dynamo-electric machines requires special instruments, since the ordinary tangent galvanometers are too sensitive for currents of 20 Webers per second, and upwards. To meet the object in view, a tangent galvanometer with an oblique coil has been constructed by M. Obach. A less perfect instrument, since it is in reality only a galvanoscope, and not a galvanometer, is that of M. Hipp. Besides these, we have the instruments constructed in the workshops of Messrs. Siemens

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and Halske at Berlin. These instruments, which have been described by M. Frölich before the Berlin Electro-technical Society, consist of an electro-dynamometer and a torsion galvanometer; the former for measuring the force of currents, and the second for determining the difference of the potentials at any two points in a circuit. These two instruments are specially constructed with a view to practical requirements. One very important point, which has been borne in mind in the construction of the electro-dynamometer, is that the apparatus should not be affected by the powerful magnetism of the dynamo-machine. The instrument in question is not novel in principle, being merely a modification of the electro-dynamometer of Weber. A coil of thick copper wire is fixed vertically on a stand, and this stationary helix is surrounded by a single turn of copper wire, suspended by a torsion arrangement and having its extremities immersed in two mercury troughs. Owing to the fact that the movable helix is here represented by one turn of wire only, the influence of external magnetism is so much weakened that the instrument may indifferently be placed in any position. The angle of torsion is proportionate to the square of the current, and consequently to the heat and light produced, or to the mechanical energy converted. Upon each instrument is indicated the "absolute constant," or the angle of torsion produced by the current of a Daniell cell through a resistance of one Siemens unit. The ratio between this current and that of one Weber per sec. is 1·13 to 1. The torsion galvanometer is so constructed that the difference of tensions in a Daniell cell produces on it an angle of torsion of about 15°. To determine the difference of the potentials at two points, a and b, in the circuit of a dynamo-electric machine, one of the terminals of the torsion galvanometer is connected to the point a; the other terminal being attached to a resistance coil of which the free extremity is connected to the point b. The resistance of the rheostat is then varied until the angle of torsion obtained corresponds with the constant which has been determined beforehand, *i.e.*, until this angle is the same as that which is obtained when the galvanometer terminals have the difference of potentials of a Daniell cell. The difference of the potentials at the points a and b is then $\frac{G+R}{G}$ *Daniells* or $\frac{G+R}{G} \times 1{\cdot}079$ *Volts;* G being here the resistance of the galvanometer, and R that unplugged on the coil. Knowing this difference of potentials, if we also know the resistance between the points a and b, the current passing is, of course, determined. Thus, calling r the last-mentioned resistance, in ohms, the current will obviously be $\frac{(G+R) \times 1{\cdot}079}{G \times r}$ *Webers per second.* The instrument devised by M. Marcel Deprez *(vide The Electrician,* No. 3 of the present vol., p. 33) may also be used for the measurement of these intense currents; but, like that of M. Hipp, it is open to the objection that it is not truly a galvanometer, but merely a galvanoscope, requiring to be experimentally calibrated before it can be employed for the comparison of currents.

City and Guilds of London Institute.—The following is the syllabus of the course of lectures to be delivered by Professor Ayrton, A.M. Inst. C.E., at the temporary class rooms of the Institute, Cowper-street, Finsbury, on "Electrical Instrument Making," Tuesdays, 8:30 to 9:30 p.m. Electro-magnets:—Kind of iron to be used for the core, action of soft iron, hard iron, steel, iron-filings, a bundle of iron wires, &c., co-efficient of magnetic induction, coercitive force. Length and diameter of core proper to be used in different cases to give the strongest magnet. Covering wire with silk, cotton, &c. Winding on the wire, test for insulation of the layers. Effect of increasing the number of turns in a layer, or increasing the number of layers of wire. Connection between the strength of the electro-magnet and the current, saturation. Best shape to give to the coils, gauge of wire proper to be used in different cases. Should different gauges be used in the different layers of the coil of an electro-magnet? Value of high conductivity copper. Effect of using coils of insulated *iron* wire for an electro-magnet, &c.—Galvanometers: Detectors are galvanoscopes only. Tangent-galvanometer, value of such a galvanometer shape of coil, length and shape of magnetic needle. Hardening and tempering of steel for magnets. Connection between the current, deflection, number of turns of wire, and diameter of the coil. Error arising from the magnet not being short. Deflection for which this error is a minimum. Gaugain's devise, conical coils, serious objection to Gaugain's plan arising from possible error due to eccentricity of needle. Helmholz's double coil tangent galvanometer. No necessity for the conical coils employed by instrument makers, shape proper to give to the channel of rectangular coils to diminish error arising from channel not being very small. Three coil tangent galvanometer is one of the best practical forms. Sine galvanometer, no necessity for the coil being circular or the magnet short. More delicate than tangent galvanometer, but can only be used for comparing constant currents. In any galvanometer the current is proportional to the deflection of the latter is very small. Delicate reflecting galvanometers, best shape to give to coils, gauge of wire to be used in the different layers, how affected by the thickness of the silk, proper resistance to give to galvanometers. Tests to be employed during the winding of the wire, method of recording the length used. Astatic combinations how practically made, measure of the astatic power. Neutralising the earth's force in other ways. Practical use of such methods. Suspending the magnets, torsion in the silk, cleaning and straining the silk fibre. Effect of putting iron in the galvanometer coils. Proper method of insulating the bobbins, and of insulating the terminals, defects of galvanometers as usually made. Dead beat galvanometers for measuring rapidly changing currents, strength of magnetic field, lightness of needle. Speaking galvanometers. Deat beat astatic combinations, construction of. Galvanometers for measuring rapidly reversing currents, such as are produced by dynamo machines. Induction on the needle of currents in leading wires, how to avoid, &c. Shunts: Theory of, material to be used for wire in the construction of. Constant total current shunts. Shape to give the outside of a shunt box, &c. Resistance coils: Resistance of a wire depends on its length, diameter, material, purity, hardness, temperature, age, &c. Choice of material and size of wire. Winding coils, insulation of, proper method to insulate ends. Testing coils, temperature corrections. Variation of temperature correction in different parts of the same coil of wire. Permanency of resisting power, annealing by time, artificial annealing of finished coils. Baking coils. Exterior of coil box, objection to highly-polished ebonite, insulation of. Suitable coils to form a set. Plugs, revolving arms, slides. Thomson's and Varley's sliding coils, principles of, construction of circular forms. Standard coils, construction and testing of. Defect in standard coils as commonly made. Hermetically sealed coils. Method of constructing cheap accurate resistance coils, &c. Condensers: Construction of, materials employed. Necessity of drying the insulating compounds. Injury done by overheating a dielectric. Modes of purifying paraffin, &c., &c.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 190.)

LECTURE III.—DELIVERED FEBRUARY 16, 1880.

Ordinary rubber, as before stated, retains its most characteristically useful properties through a very limited range of temperature, as a very moderate degree of cold on the one hand, or of heat on the other hand, suffices to render it valueless, as regards the major part of its industrial uses.

At 0° Centigrade, caoutchouc is hard and rigid; while, at 100°, it becomes so soft as to become almost valueless as an elastic material. The consequence is that india rubber, in its natural condition, has a very limited applicability in connection with the industrial arts.

The above-mentioned defects of india rubber may be, to a most remarkable extent, removed by causing it to unite chemically with a small proportion of sulphur; and, not only does the sulphurised caoutchouc resist the effects of heat or cold, but it also refuses to dissolve in the greater part of those liquids which are solvents of the crude material. The credit of having originated the process of sulphurising or vulcanising caoutchouc appears to rest principally with Charles Goodyear, who laboured in the United States, and Thomas Hancock, who experimented in this country. In a patent, dated November 21, 1843, the last-mentioned gentleman describes in detail several of those methods of performing the operation of vulcanisation, which are in use at the present time; and he distinctly recognises the fact that the over-vulcanisation of india rubber leads to the production of a hard, black substance, resembling horn, this substance being now extensively used under the names of ebonite or vulcanite.

Let us now study the effect of sulphur on caoutchouc, by immersing some strips of the substance in baths of melted sulphur. Here, in the first place, is a cast iron vessel, containing sulphur in a fluid state, and an inspection of the thermometer standing therein shows that the temperature of the bath is 120° Centigrade. A thin strip of caoutchouc is next partially immersed in the melted sulphur. Now, what is happening? The caoutchouc is absorbing the liquid sulphur, just as it would absorb benzole or coal naphtha; and the caoutchouc swells under the influence of the liquid sulphur, just as it did under the influence of the benzole, only the degree of swelling is far less in the case of the melted sulphur. I will now take out the strip of caoutchouc, and dip it into cold water. You see that the melted sulphur adherent to its surface has cracked up into innumerable fragments, and these are easily removed by a gentle friction on the surface of the rubber. Now, examine that portion of the caoutchouc which was immersed in the sulphur bath; it has become light yellow, and has, probably, now absorbed between 10 and 15 per cent. of sulphur. If, however, it had been allowed to remain in the sulphur bath (at 120° Centigrade) for a much longer period, it would have absorbed nearly half its weight of this substance. The caoutchouc which has thus absorbed sulphur differs as regards elasticity, &c., but little from ordinary caoutchouc, because the sulphur is merely disseminated through its pores, and not chemically united. The india rubber in this state is subject to the stiffening influence of cold, and dissolves in the ordinary solvents of caoutchouc. By the further application of heat, however, combination or chemical union of a portion of the sulphur with the caoutchouc may be caused to set in, and then the india rubber becomes truly vulcanised. Now, then, let me put this strip of caoutchouc, which has already absorbed sulphur, into a bath of glycerine, heated to 140° Centigrade; and if you examine it after the lecture you will find it perfectly vulcanised. Instead of taking the strip of caoutchouc out of the sulphur bath, and placing it in a vessel of heated glycerine, it might have been allowed to remain for some hours in the sulphur bath, when true vulcanisation would have taken place, especially if the temperature had been slightly raised; but, in this case, the result would have been less satisfactory, as an over-large proportion of sulphur would have been absorbed. If, however, one commences the operation with a sulphur bath heated to 135° or 140° Centigrade, the vulcanisation of a thin sheet of caoutchouc may be completed in a few minutes. Here is a bath of liquid sulphur heated to 138° Centigrade; and here is a similar vessel, containing sulphur, maintained at a temperature of 143° Centigrade. Into each of these I will place a thin strip of caoutchouc. You see now that both strips are fairly vulcanised after having remained four minutes in the sulphur. Had these strips been allowed to remain for a much longer period in these hot sulphur baths, they would have become over-vulcanised, or converted into a horn-like substance. In these cases the two stages are traceable:—

1st Stage.—The incorporation of sulphur with the rubber by absorption.

2nd Stage.—The chemical union of the sulphur with the rubber.

Rubber which contains sulphur incorporated with it may be conveniently referred to as "mixed rubber," in order to distinguish it from vulcanised rubber, or rubber which has chemically reacted or combined with sulphur. It is, at present, a matter of uncertainty whether the change which takes place on heating the "mixed rubber" consists in the direct combination of this element with the caoutchouc, or in the replacement of a portion of that hydrogen which exists in the caoutchouc by an equivalent qantity of sulphur; but this latter view of the case is confirmed by the fact that a trace of sulphuretted hydrogen is always evolved during the mutual reaction of sulphur and caoutchouc. It is, however, certain that the proportion of sulphur actually concerned in working the change called vulcanisation is extremely minute; although it is necessary, in most cases, for a considerable excess of sulphur to be present during vulcanisation.

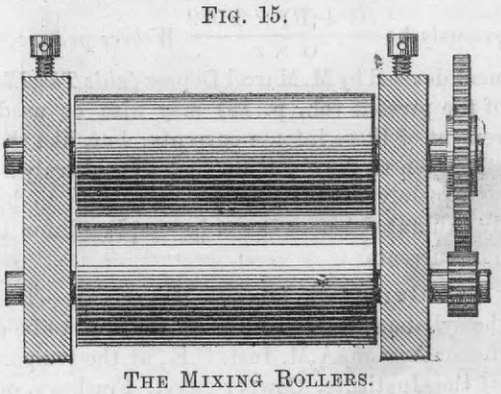
The process of vulcanisation by means of the sulphur bath is one which offers many inconveniences when carried out on an industrial scale, although it is admirable as a laboratory process, or as a means of studying the operation of vulcanisation. If large articles are to be operated upon, it is by no means easy to ensure an equable action of the sulphur, as it is difficult to keep all parts of the bath at the same temperature; and, when some portions of an article are thin while others are thick, it is scarcely practicable to vulcanise the thick parts all through without overdoing the thinner portions of the article. Again, weights or frames must generally be provided, in order to keep the india rubber fairly beneath the surface of the melted sulphur, and any trace of solvent remaining in the joints of the goods often becomes volatilised in the bath, causing "blow-holes" or other defects.

These circumstances have made it more general for manufacturers to incorporate the sulphur with caoutchouc by mechanical means, and then to fabricate the "mixed rubber" into the required forms; after which, vulcanisation is brought about by exposing the articles to the required temperature. This mode of procedure affords an opportunity for the admixture of mineral or other matters with the caoutchouc, such additions being often necessary, either to colour the material or to give it that hardness which is occasionally required; while it is often advisable to replace the sulphur, either partially or entirely, by certain metallic sulphides, such as vermilion or the orange sulphide of antimony; but these sulphides have scarcely any vulcanising action, unless they contain some free sulphur.

The apparatus employed for incorporating sulphur with the caoutchouc consists of a pair of rollers, which somewhat resemble the washing rollers, only they are plain on the face, and revolve at unequal speeds—three to one being a usual difference between their rates. The lantern slide which is now projected on the screen (Fig. 15) will give you some notion of these rollers.

The rollers having been heated inside by means of steam, a charge of about 30 lbs. of the washed sheet rubber is worked through the machine until it has become tolerably softened and

FIG. 15.



THE MIXING ROLLERS.

plastic; after which powdered sulphur is sprinkled on the rubber as it enters between the rolls; and this sprinkling on of sulphur and working is continued until all the material is thoroughly incorporated. In ordinary cases 3 lbs. of sulphur to a 30-lb. batch is the proportion employed, and the soft mixed rubber may be further manipulated at once or it may be stored away for future use. In most cases the next step is to roll the material into sheets, as the major part of india rubber articles are built up of

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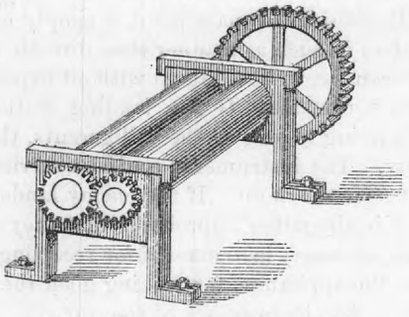
these; and for the purpose of fabricating these sheets a large rolling machine called a calender is employed, but before being rolled out by means of this machine it is necessary to thoroughly warm and knead the mixed rubber in order to make it plastic. For this latter purpose the warming rollers are made use of (Fig. 16), these being very similar to the mixing rollers, only they run at nearly an equal speed. The object of making a slight difference between the rates of the two rollers is to give

Fig. 16.



THE WARMING-UP ROLLERS.

the softened rubber a tendency to remain on one roller (that which revolves most slowly). It is scarcely necessary to say that the warming-up rollers are heated internally by means of steam.

(TO BE CONTINUED.)

LITERATURE.

A Physical Treatise on Electricity and Magnetism. Two vols. By J. E. H. GORDON, B.A. [Sampson Low, Marston, Searle and Rivington].

SECOND NOTICE.

In our issue for June 26th, we called attention to the publication of this work, and it now behoves us to speak of it more in detail.

The student who desires to undertake original research will find herein descriptions of those wonderful instruments which have enabled modern physicists to pursue their investigations so far into the regions of the unknown. Mr. Gordon has entered with anatomical mintueness into these descriptions, determined that the reader shall understand not only what the instrument as a whole is for, but also the part played by every section, and hence he dissects with a master hand, and with a master's pen gives concise and graphic details relating to every screw and rod entering into the construction of the instrument. Thus he discusses the various forms of Thomson's electrometer, batteries, commutators, galvanometers, &c. The instruments are not only described, but the "why" they are so made, and the "how" they are used, are subjects carefully and succinctly considered. The work, in fact, is altogether unique in its description of apparatus.

The author has in the first volume discussed very fully the question of "specific inductive capacity." We, perhaps, look upon this more from a utilitarian point of view than from the speculative; but Mr. Gordon evidently understands the former, though we imagine he was induced to treat this branch of the subject as a speciality, because it presented a fine field for speculation as to the exact nature of "electricity." This may be gathered from the following extract taken from p. 70:—

"The determination of the specific inductive capacities of different dielectrics is one of the most important branches of electrical research.

"It is of the very greatest commercial importance, for in submarine telegraphy the number of words per minute which can be transmitted through the cable—that is, the gross receipts of the company—depend, in a great measure, on the lowness of the specific inductive capacity of the insulator of the cable.

"In choosing between different insulators, it is therefore absolutely necessary to have an accurate knowledge of their capacities.

"In the the theoretical study of electricity it is even more important, for, as we shall show in Part IV. of this book, the theory which offers us the fairest hopes of some day finding out exactly what electricity is, requires certain relations between the specific inductive capacities and the refractive indices of transparent dielectrics. It is only by accurate determinations of specific inductive capacities that this theory can be experimentally tested.

"We shall, therefore, give a very full account of all the determinations of specific inductive capacity which have been made up to the present time.

"We must premise that the experiments are of an extremely difficult and complicated nature, and that the numbers obtained for the same substance by different observers differ very widely. . . ."

The history of researches upon "specific inductive capacity" is a little curious, and we should not be surprised to learn that, even to the strong array mentioned in this work, other names must be added. The work of Cavendish between 1771-81 was practically unknown till last year, and, in fact, we doubt if it is known to more than a score of people even now. Mr. Gordon's book will do more to indicate the scope of Cavendish's experiments than the book edited by Maxwell, and published by the Cambridge University Press. This, we may say, is the fault of the publishers, who, imbued with their own omniscience, have not thought it worth while to take the ordinary steps to make the work known. To return to our immediate subject. The researches of Faraday, Gibson, and Barclay, Boltzmann, Romich, Fajdiga, and Nowak, Schiller, Silow, Wüllner, Hopkinson, the author himself, and Ayrton and Perry are discussed, a table being given showing at a glance the results obtained by these experimenters. As previously stated, Mr. Gordon has made this subject a special study, and hence this chapter forms probably the most complete account of the subject in this or any other language. An appendix is added to the chapter, giving Professor Boltzmann's explanation of his formula for calculating the specific inductive capacity of a dielectric ball from the ratio of the attraction of it, and of a conducting ball, by a charged ball. The formula in question is K (the specific inductive capacity).

$$E = \frac{K + 2}{K - 1}$$

$$K = \frac{E + 2}{E - 1}$$

E is the ratio of the attractions of metal and dialectric balls. It is not every one who dabbles in experimental research that has the power of lucidly describing the work performed and the apparatus used, but our author seems to possess this power to an extraordinary degree. The reader can hardly fail to understand what has been done, why it has been so done, and the results obtained.

After the division on electro-statics comes Part II., devoted to magnetism. Here again we find exceptionally good descriptions of apparatus, especially in Chapters XIV and XV., dealing respectively with "Terrestrial Magnetism, Modern Experimental Methods, and Self-recording Instruments." The instruments described are principally those in use at the Kew Observatory. Chapter XVII. deals with earth currents, and is practically a summary of Mr. C. V. Walker's investigations. It may be interesting just at this time, when, from various quarters, special attention is directed to earth currents, to recall Walker's summarised results. We give them as quoted by Mr. Gordon:—

1. That currents of electricity are at all times moving in definite directions in the earth.
2. That their direction is not determined by local causes.
3. That there is no apparent difference, except in degree, between the currents collected in times of great magnetic disturbance and those collected during the ordinary calm periods.
4. That the prevailing directions of earth currents, or the currents of most frequent occurrence, are approximately N.E. and S.W. respectively.
5. That there is no marked difference, duration, or value between N.E. and S.W. currents.
6. That (at least during calm periods) there are definite currents of less frequency from some place in the S.E. and N.W. quadrants respectively.
7. That the direction of the current in one part of a plane on the earth's surface (at least as far as the S.E. district of England is concerned) coincides with the direction in another part of the plane; and if the direction changes in one part it changes in all parts of the plane.
8. That the relation in value between currents in a given part of the plane and currents in another given part is not constant, but is influenced by local meteorological conditions, and varies from time to time.
9. That the value of a current of a given length moving in a given line of direction is not necessarily the same as that of a current of the same length on the same line of direction produces, and that their relative value depends on the physical character of the earth interposed between the respective points of observation and is tolerably constant.

The other conclusions simply refer to the currents under investigation being real earth currents, exercising a direct action upon magnetometers.

The succeeding part of this work is devoted to electro-kinetics, and must form the subject of a future notice.

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INTERNATIONAL LAW AND SUBMARINE CABLES.

During the sitting of the International Telegraph Conference last year we called attention to the unsatisfactory state of international law as regards submarine cables, vol. iii., p. 46. We are glad to find that this question is making headway, as will be seen from the fact that Sir Travers Twiss made it the subject of a paper read at the recent conference on the Law of Nations held at Berne. Two points require consideration and settlement, the one relating to wilful or accidental damage done to a cable during a period of peace, whether committed within or without the three mile radius, the other relates to the position of cables during periods of war. These two points have been formulated in two resolutions. (1). That it is highly desirable that the Powers interested should agree in the establishment of the rule—that the intentional destruction or injury of telegraph cables under the high seas in time of peace is an offence against the Law of Nations, and that it should be determined by the nations interested what the precise penalty should be attaching to such an offence with such a degree of uniformity as is compatible with the criminal laws of the several States; the right of capturing the offenders abroad by the public vessels of all nations; the right, however, of judging the offenders to be reserved to the tribunals of the country to which the captured belong. (2.) In time of war the cables which unite neutral territories should be deemed as inviolate. Further, it is desirable that when telegraphic communication must cease in time of war that the belligerent should limit his dealings with the telegraph to such measures only as are absolutely necessary to prevent the use of the cables, and that these measures should cease, and the cable be at once restored to use immediately upon the cessation of hostilities, or at least as soon after as possible.

The difficulty of determining the penalty for wilful damage to a cable is not insuperable, but it will tax the ingenuity of international law makers to the utmost. We incline to the belief that it is not the severity of punishment but the certainty that exercises the greatest deterrent effect, and evidently this is what we require in the present case. It will be interesting to know the result of the discussion on these points at the meeting now being held at Oxford. It seems certain, however, that whatever difficulty there may be in the first case of apportioning a punishment the second is quite clear. The interest of all the parties concerned is to have good cable communication between countries separated by water and yet connected by commercial relations. In the case of war, therefore, the main point is simply to render the cable ineffective in such a manner that directly the war is concluded it can be utilised again without expensive operations and waste of time. If the landing station is on the mainland belonging to one of the belligerents, this presents little difficulty. The instruments could be carried away, and the cable cut near the shore. If the enemy landed exactly at the station it is altogether improbable that they would have with them the necessary instruments for receiving or sending messages, or the appliances for making good the fault, so as to use the cable for the purposes of the war.

It may be said that cable property must take its chances with other property belonging to private individuals, but we maintain that it is altogether different in its nature. The civilised world owes most of its progress to the exertions of individuals, and if we are to look upon progress as the normal condition of things, such exertions must be fostered. There is a limit, however, to the energies of business men, when the return is absolutely unsafe. So long as the return may be large or small, according to certain cycles of operations, men will be found to risk money and exert energy, but the moment it is shown that the return can never be commensurate with the risk, then capital will seek new fields. We do not say that cable risks, even accepting war as inevitable and the destruction of cables certain during war, are absolutely unsafe, but we do hold that should nations not accept the responsibility of protecting cables the fact should be fully understood, as it would enable the proprietors to provide for and insure against such risks. So far as we know, the only cables that have suffered through war are those on the West Coast of South America, and here the shareholders have to deplore a total loss of revenue, and a possibly heavy outlay to repair the damage done by the combatants to the cable. Ships can be moved out of harm's way, or protected in convoys by men of war, but there is no possibility of protecting a cable from wanton mischief. Any nation possessing ships can cause damage to the extent of hundreds of thousands, if not millions of pounds.

To return, however, to the perhaps more important question of wilful and accidental damage in time of peace, some of the companies have widely distributed instructions requesting immediate and precise information whenever a ship accidently injures a cable, and even go so far as to guarantee compensation for the loss of any tackle that may be sacrificed on finding the vessel's anchor, &c., caught in a cable. The Congress has before it not such accidental but any wilful damage, and it seems to us obvious that any penalty should preclude the possibility of the same person ever again being able to perform such an act. The pecuniary loss resulting from the damage to a cable can hardly be estimated, when such cable forms the sole method of quick communication between widely distant places. When there exist duplicate routes, the damage may be calculated in pounds, and estimated at a money value. These different cases will, no doubt, be discussed by the Congress, and as we have already stated, most of those engaged in cable work or having investments in cable shares will be anxious to hear the conclusions to which the delegates arrive.

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INVIOLABILITY OF SUBMARINE CABLES.

At the Conference on the Law of Nations, recently held at Berne, Sir Travers Twiss read a paper on the international protection of sea cables. The purport of this paper was to review the conclusions at which the Institute of International Law, now in session at Oxford, had arrived last year at its Conference in Brussels, under the presidency of M. Rolin Jacquemyns, the Minister of the Interior. M. Louis Renault, Professeur à l'École des Sciences Politiques à Paris, it appears, has submitted an interesting report on behalf of the institute, which, after considerable discussion, has given rise to the following resolutions :— (1.) That it is highly desirable that the Powers interested should agree in the establishment of the rule—that the intentional destruction or injury of telegraph cables under the high seas in time of peace is an offence against the Law of Nations, and that it should be determined by the nations interested what the precise penalty should be attaching to such an offence with such a degree of uniformity as is compatible with the criminal laws of the several States; the right of capturing the offenders abroad by the public vessels of all nations; the right, however, of judging the offenders to be reserved to the tribunals of the country to which the captured belong. (2). In time of war the cables which unite neutral territories should be deemed as inviolate. Further, it is desirable that when telegraphic communication must cease in time of war that the belligerent should limit his dealings with the telegraph to such measures only as are absolutely necessary to prevent the use of the cables, and that these measures should cease, and the cable be at once restored to use immediately upon the cessation of hostilities; or at least as soon after as possible. It appears from the *Journal Télégraphique*, of 1877, that the telegraphic sea cables owned by private companies at the time of that report had an extent of 60,000 nautical miles, whilst those which were State property extended over 4,400 miles. Our modern civilisation, and the entirely new condition under which both States and Communities are placed by the material inventions of the age, give rise to many and novel relations, for which the practical jurist must do his best to provide, not to speak of the conflicting interests which sooner or later may jostle one another under the rough and hard usages of war. Sir Travers concluded an interesting paper by pointing out in a complimentary manner the unique interest which Switzerland had in the maintenance of friendly relations, and the adjustment of rules to govern the future of the present unusual modes of communication between different nations. Switzerland has executed most gigantic works—piercing Mont Cenis and Mont St. Gothard, in order to facilitate the communication between the north and the south of the continent of Europe, thereby extending the line of communication from the countries of Europe to the extreme Orient. A cincture of lightning now engirdles the globe, and it becomes the duty of all nations to shelter that girdle from being maliciously snapped asunder, or destroyed by the red hand of war. No single State can hold dominion over an invention of prime practical importance to the happiness and interests of mankind; all nations should exercise vigilance and become its protectors.

HENLEY'S TELEGRAPH WORKS COMPANY.

Henley's Telegraph Works Company are getting quite busy. They have just completed, first, a 12-mile length of cable for the Danish Government. This cable has seven conductors, of 107 lbs. copper and 120 lbs. gutta percha, closed with sixteen No. 5 galvanised iron wires, with two coatings of tape and compound. This order was executed in a week. Secondly, a 1-mile length of cable for the Danish Government, to repair a cable across the belt made by Mr. Henley in 1863. This type has three conductors of 66 lbs. copper, covered with gutta percha, to gauge No. 1 B.W.G., closed with twelve No. 000 wire ungalvanised. They have also in hand five miles of six conductor cable for the Submarine Telegraph Company. The conductors have 107 lbs. copper, and 140 lbs. of gutta percha, and are closed with 12 No. 1 galvanized iron wire, and covered with yarn and compound. Eight miles of torpedo cable are also in hand for the Danish Government, and the same length for our own War Department, each with india rubber core.

The company have also just obtained the order by open tender for the following lengths of cable from the West India and Panama Telegraph Company; 40 n. miles of deep sea single conductor 107lbs. copper, 140lbs. gutta percha covered with 16 No. 13 homogeneous iron wires with two sewings of jute and compound; 15 n. miles of same core covered with 12 No. 5 iron wires, and 15 n. miles with 12 No. 9 wires, in all 70 miles. It would thus appear that the Henley Company is obtaining a fair amount of work.

ON THE PROPER FORM OF LIGHTNING CONDUCTORS.*

BY WILLIAM HENRY PREECE, M.I.C.E.

A lightning conductor erected for the protection of a building consists of a ribbon, rod, chain, rope, or other mass of metal attached to the highest point of the structure, and descending to the earth. What shall be the form of this conductor? has been a vexed question from the days of Franklin to the present. Shall it be dependent on extent of surface or on sectional area? In other words, does the transferrence of electricity, when the potentials are so high as to cause lightning discharges, obey the laws of Ohm, or is this law modified by the presence of some fresh condition? Snow Harris was a very warm advocate of the surface form. He used flat ribbons for his ships, and tubes for his buildings. Henry, of Washington, believed in the efficacy of surface. According to him, frictional electricity passes at the surface, galvanic electricity through the mass. M. Melsens is found on the same side, and Guillemin, of Paris, led many French electricians to favour the same view.

On the other hand, Faraday almost angrily espoused the opposite side. "As respects electrical conduction," said he, "no advantage is gained by expanding the rod horizontally into a strap or tube. Surface does nothing; the solid section is the essential element."

The advocates of the solid and cylindrical form argue that the lightning conductor is simply a path by which electricity is transferred from a point of high potential (an electrified cloud) to a point of lower potential (the earth), and that its efficacy depends solely upon its resistance. It obeys the law of Ohm, and its efficacy is therefore for the same material dependent on its mass and sectional area.

The advocates of surface argue, that as in all cases of static charge electricity exists only on the surface, so when electricity of "high tension" is conducted away it is the surface that plays the prime part, and, therefore, the greater the surface the easier the path to the discharge. Again, they say when a cylindrical conductor conveys a charge of electricity it is raised to a "high tension," and is rendered capable of doing mischief; but with the same charge, the greater the surface the less the density on the surface, and, therefore, the greater the safety. In other words, with a given quantity of electricity, the greater the surface the less the potential. Moreover, they urge, since according to Guillemin currents of electricity flowing in the same direction retard each other with a power varying with the distance separating them, and since a rod may be considered as a bundle of smaller but parallel rods, so a current of electricity may be considered as being made up of many parallel currents, each retarding the other. Hence, a ribbon will conduct better than a rod, because the currents are spread further apart, and retard each other less. These arguments have led to the employment of unsightly ribbons and expensive tubes, which have considerably interfered with the establishment of this very necessary element of safety to buildings.

The arguments in favour of the surface form are, in the opinion of the author, deductions from exploded theories, from imperfect experiments, or from erroneous interpretations of well-ascertained facts. No direct experiments have ever been made to solve the question, as far as the author knows. Quantities of electricity, that is static discharges from condensers, are in incessant use for telegraphic purposes, and are found to follow exactly Ohm laws, even with the most delicate apparatus. The knowledge of the flow of electricity through conductors, of the retarding influence of electro-static capacity upon this flow, and of the distribution of charge, has become so much greater of late years through the great extension of submarine telegraphy and the labours of Sir William Thomson, Clerk Maxwell, and others, that I question if any English electrician would now be found to argue in favour of the surface form. Nevertheless, ribbons and tubes still continue to be used, and it appeared very desirable to settle the question experimentally. I determined to try and do so.

First Experiments, June 28, 1880.

Dr. Warren de la Rue, who is always ready to place his splendidly-equipped laboratory at the service of science, not only allowed me to use his enormous battery and his various appliances, but aided me by his advice, and assisted me in conducting the experiments.

Copper conductors, 30 feet long, of precisely the same mass

* Read at the late meeting of the British Association.

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(*a*), drawn into a solid cylinder (*b*) made into a thin tube, and (*c*) rolled into a thin ribbon, were first of all obtained. The source of electricity was 3,240 chloride of silver cells. The charge was accumulated in a condenser of a capacity of 42·8 microfarads. It was discharged through platinum wire of ·0125 diameter, of different lengths. The sudden discharge of such a large quantity of electricity as that contained by 42·8 mf. raised to a potential of 3,317* volts is very difficult to measure. It partakes very much of the character of lightning. In fact the difference of potential per unit length of air is probably greater than that of ordinary lightning itself. It completely deflagrates 2½ inches of the platinum wire, but by increasing the length of the wire it could be made to reproduce all the different phases of heat which are indicated by the various shades of red until we reach white heat, fusion, and deflagration. Hence the character of the deflagration, which is faithfully recorded on a white card, to which the wire is attached, by its scattered particles, is a fairly approximate measure of the charge that has passed, while the length of wire, raised to a dull red heat, is a better one, for any variation in the strength of the current within moderate limits is faithfully recorded by the change of colour.

Experiment 1.—Similar charges were passed through the ribbon tube and wire, and in each case 2½ inches of wire were deflagrated. No difference whatever could be detected in the character of the deflagration.

Experiment 2.—Ten inches of wire were taken and similar charges passed through. In each case the wire was raised to very bright redness, bordering on the fusing point, and in two cases the wire broke. In each case the wire knuckled up into wrinkles, and gave evidence of powerful mechanical disturbance. The same wire was not used a second time. No difference could be detected in the effect through the different conductors.

Experiment 3.—Silver wire of the same diameter and length was used, and similar charges transmitted through it. Redness was barely visible, but the behaviour of the wire was similar in each case.

The conclusion arrived at unhesitatingly was that change of form produced no difference whatever in the character of the discharge, and that it depended simply on mass.

Second Experiments, July 19, 1880.

As it might be urged that the length of conductor tested was so short, and its resistance so small that considerable variations might occur and yet be invisible, similar lengths (30 feet) of lead —a very bad conductor, its resistance being twelve times that of copper—were obtained, drawn as a wire, made as a tube, and rolled as a ribbon, each being of similar weight.

Experiment 4.—Charges from the same condenser, 42·8 mf., but with 3,280 cells, were passed through, and the discharges observed on 6 inches of platinum wire 0·0125 inches diameter, which in each case was heated to bright redness. No variation whatever could be detected, whether the wire, the tube, or the ribbon were used.

Experiment 5.—In order to form some idea as to how closely we could estimate any variation in the character of the discharge, we used a long piece of platinum wire and adjusted the lengths until we obtained just visible redness ; then a diminution of 10 per cent. (3 feet) produced a marked change to dull redness, and further excisions raised the temperature to brighter and still brighter red.

The conclusion arrived at was that any change in resistance of 5 per cent. would have been clearly and easily discernible.

It therefore appears proved that the discharges of electricity of high potentials obey the laws of Ohm, and are not affected by change of form. Hence, extent of surface does not favour lightning discharges. No more efficient lightning conductor than a cylindrical rod or a wire rope can therefore be devised.

ON THE NECESSITY FOR A REGULAR INSPECTION OF LIGHTNING CONDUCTORS.†

BY RICHARD ANDERSON, F.C.S., F.G.S.

One of the most valuable suggestions which has been made in connection with lightning conductors was that by M. W. de Fonvielle in his paper "On the Advantages of Keeping Records of Physical Phenomena connected with Thunderstorms," read before this Association in 1872. In that paper M. de Fonvielle referred to the steps taken by the French Government for having maps drawn of the course followed by thunderstorms ; and he reminded the Association that the French Academy of Sciences as far back as 1823 recommended the Government of France to establish a record of cases of damage by lightning to buildings which had been supplied with lightning conductors. He pointed out that the efficiency of lightning conductors had been questioned, and that in Manchester a conference held on the occasion of Kersal Church being struck had arrived at the conclusion that lightning conductors were worse than useless.

Although it was suggested by M. de Fonvielle that this Association should establish some organisation for the collection of such data, no results have, so far as I am aware, been published.

In my paper "On Lightning Conductors, and Accidents by Lightning," read before this Association in 1878, I cited two cases of damage to buildings provided with lightning conductors, which, on a careful investigation of the facts, showed that the lightning rods were inefficiently erected. On the present occasion I wish to bring under the notice of the Association a few cases which have come under my own observation of damage resulting to buildings which had lightning conductors attached. The adducing of such cases furnishes the best argument, I imagine, not only for a record being kept of all accidents ; but of a regular inspection of buildings which have lightning conductors attached to them.

On the 10th of October, 1878, a furniture repository situated at the back of Victoria Station, Westminster, was struck by lightning, although a conductor was attached to the building. The warehouse, which is built of brick, is 110 feet, by about 80 feet wide, the roof is flat and covered with lead. At the south-east corner, a slate covered tower with four feet of iron cresting rises to the height of 20 feet above the roof. To this ornamental iron-work a solid copper band lightning conductor ¾″ broad × ⅛″ thick, and weighing ·43lbs. per foot was attached. A terminal made of ⅝″ dia. copper tube, with three discharging points 6 inches long, screwed into the rod 3 inches from the top, rose three feet above the iron cresting. The rod was attached to the ironwork by means of copper wire, and the band to the slates and brick work by gun metal clips. The copper was of very good quality, having a conductivity of 92·00 per cent. The electric discharge fell on the point of the lightning conductor, bending it, driving out two of the discharging points and twisting the third. The iron cresting was shattered, and considerable damage done to the tower. Part of the discharge was, no doubt, carried off from the lead roof by the rain water pipes, which were in metallic communication with it. On testing the conductor shortly after the accident, I got no deflection of the galvanometer needle, and on opening out the earth terminal found the conductor carefully insulated in concrete.

On the 10th of June last, lightning struck the point of the conductor at St. Mark's Church, Skelton, slightly bending it; but did no further damage. The conductor was made of ⅝″ dia. copper rope, and had a conductivity of 52·50 per cent. On testing the conductor, while rain was falling, I found the resistance to be 600 ohms. The conductor was buried 9″ among bricks, lime, &c., and carried 15 feet from the building.

On Saturday, the 26th of June, 1880, a heavy thunderstorm passed over South Lambeth, the lightning doing considerable damage to All Saints' Church. A stone cross 4 feet high stands on the apex of the west gable of this building, and another of similar size stood 92 feet 6 inches from it on the east end of the nave, a ridge of red tiles separating them. A ⅜″ dia. copper rope conductor consisting of 49 wires was attached to the cross on the west gable, a 5 feet point made of copper tube rising 18 inches above it. On the afternoon of the 10th lightning was observed to strike the point of the conductor, then dart to the stone cross on the east nave, throwing it down and injuring the roof of the north aisle. On testing the conductor a few days after the building was struck I found the lightning rod had no "earth" whatever, the rope being simply stuck 2 inches in loose rubbish. The copper was very impure, the conductivity being only 32·10 per cent., or about double that of iron.

In July last about half-past five in the morning, lightning struck one of the chimneys of Normanhurst Court, near Battle, Sussex, notwithstanding a lightning conductor was attached to it. There were two lightning conductors on the buildings. One on an octagonal tower, which rises from the S.W. angle, having a balcony and a lofty stone spire, about 120 feet high, the other on the S.E. chimney, which was struck, about 126 feet distant from the tower. The lightning conductors consisted of twelve copper wires, 15 B.W.G. woven into the form of a band an inch broad, and weighing ·36lb. per foot. The air terminal, which rose 3 feet above the chimney coping, consisted of an iron point 12 inches long, covered with a composition which on scraping appeared to be lead, this was attached by means of a coupling joint to a copper tube 6 feet long, and weighing ·28lb. per foot. The copper band was connected to the rod by another coupling joint. The chimney coping consisted of eight ornamental stone pinnacles

* The electromotive force of the chloride of the silver cell is 1·03 volt.

† Read before Section A of the British Association at Swansea, Aug. 27, 1880.

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3 feet high and 2 feet square at the base. The terminal rod was placed on the centre of the chimney—and insulated from it. The lightning discharge struck the chimney, destroying three of the pinnacles, which falling through the roof below did considerable damage. The air terminal was bent, and the composition on the point melted 3 inches. The wires near the terminal point were likewise partly fused, and on taking out one wire 25 feet below the terminal rod, I found it so irregular in thickness that it had to be redrawn before the conductivity could be determined. On testing the earth terminal I could get no deflection of the galvanometer needle, the conductor being buried in dry earth within a stone wall 8 feet above the fosse, or asphalted area. The conductor on the tower had "good earth." The conductivity of the copper was 80·5.

From the instances quoted, it is evident that it is not sufficient merely that rods of copper should be attached to a building, but it is necessary that once put up they should be regularly inspected to see if they are in good order, so as to be really efficacious. That this is rarely done is one of the main reasons why accidents by lightning occur in places nominally protected by conductors. It is, perhaps, not too much to assert that at present not one in a thousand of our public buildings in England is regularly tested.

There can be no manner of doubt that in the matter of lightning conductors they manage things better on the other side of the Channel than with us. The French Government are in the constant habit of consulting the most eminent scientific men on the subject of protecting public buildings against the destructive influence of lightning. There is scarcely an instance in which a British Government ever did such a thing. It is true the Houses of Parliament had lightning conductors erected upon them at a very great cost and under scientific advice; but all who understand the subject practically agree in saying that it is very doubtful whether the magnificent pile of buildings in which our legislators assemble is really—that is efficiently—protected. At all events I understand the earths have never been tested since the conductors were erected in 1852. That the Victoria Tower should have been struck in June, 1868, and slightly damaged tends to show that the conductors at that time were not in an efficient state.

From the examination I have made I am pretty correct in stating that one-half of our cathedrals and three-fourths of our churches have not even nominal protection. For all that science has done the Queen might any day be killed in her apartments at Windsor Castle, the Prince of Wales in Marlborough House, and the Prime Minister in Downing-street. To see the difference between England and France in this respect, one has but to cross the Channel between Dover and Calais. At Dover there are huge barracks of great length, on the top of high hills, exposed to the full fury of storms sweeping across the Channel, and the few conductors to be found upon them at long intervals are certainly not numerous enough for efficient protection against lightning, and their efficiency has never, so far as I can learn, been tested. The contrast in this respect on crossing the Channel is of the most striking. At Calais, the Hotel de Ville, in the Grand Place, literally bristles with lightning conductors, and so all the churches and chief buildings in the town. The same all over France, Germany, and Belgium. Without slavishly imitating our scientific neighbours, we might yet bestow some of the care they do upon the protection of our property as well as of our lives against the terrible effects of the electric force.

AN IMPORTANT PROBLEM AND ITS SOLUTION.*

BY THEODOR WIESENDANGIR.

The powerful impulse given to scientific research and inventive effort by the rapid progress in the development of the electric light during the last two years, has produced the most promising results with regard to the production and employment of powerful electric currents for practical useful purposes. In these results, as already achieved, the scientific mind cannot fail to detect the embryo of a grand system of production and transmission of energy through conversion of forces, which is to supersede in times to come the means and methods at our command in the present century for generating motive energy through combustion. Remote as the date may be when the vast accumulations of coal which now serve to impart life to our prime motors shall all be consumed, and the mines all exhausted, yet that epoch will and must come, as surely as our supply of combustible fuel is limited, as surely as we now consume the light and heat-producing carbons in a manner both wasteful and thoughtless. Numbers of coal mines in this country are already abandoned, their resources being exhausted, and when the last of them is delivered up to that destruction which is brought about by time, wrought by oxidation, slow and sure, nay, before that time has come, a grand problem is to be solved. Science must then have discovered new principles, invented new methods and novel appliances, able to supersede the agencies at work in the present era, to cheer our homes with light and heat, to supply us with the vast motive energy that animates the thousand living mechanisms of our industries and factories.

Perhaps it is natural that our present generation should find it difficult to disassociate the idea of generation of caloric, luminous and motive energy, from that of combustion, the rapid oxidation of fuel, and that the solution of the problem spoken of above is sought merely in the substitution of the consumption of carboniferous matter by that of some other substance.

A change more thorough is, however, to be wrought. There are powers at our command already by means of which motive energy, light, and heat, can be excited and transmitted to considerable distances, and the scientific mind has found indications, sure and true, which create a conviction that, as the secrets of these forces are investigated and more and more brought to light, so the transmission of heat as well as that of luminous and motive energy will no longer be limited by space. Electric currents of almost any power can be, and are now, both naturally and by artificial means, produced independently of either slow or rapid oxidation. The friction created by wind and water, the action upon each other of different parts of the globe, unequally heated, excite powerful currents of electricity unknown to and left unemployed by the human race. The tides that sweep our shores and ascend our rivers are another grand creative source of motive energy, unlimited, unexplored, and idle. Let this fertile source of energy be utilised, the difficulties in our way can be surmounted, and the energy thus obtained may, with little loss, be converted into electric currents less limited by distance, currents powerful enough to melt our steel, to illuminate our public promenades and streets, to plough our very fields, and animate the iron-sinews of our innumerable factories.

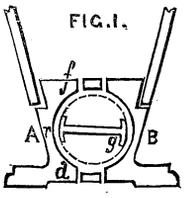
Attempts have been made in this country to transmit the power of a waterwheel, driven by a waterfall, through the agency of conversion of forces. A well-known gentleman succeeded by these means in lighting his library, and in driving machinery stationed at a very considerable distance from the prime source of energy. It was found, however, that further researches and new discoveries and inventions are to be made before the same process can be extensively applied to practical useful purposes.

Since then a similar project, but on a scale far larger, has been undertaken, and is being carried on in America, and should it finally prove a success it it proposed to employ the Falls of Niagara as the central source of motive power for all the neighbouring country.

All the results hitherto obtained point to the fact that one of the greatest difficulties met with in this field of work is the inefficiency of the dynamo-generators, and especially of the electro-motors of our present time, together with our as yet imperfect and fragmentary knowledge of electrical energy.

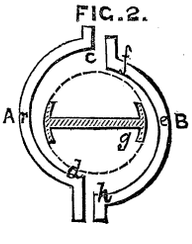
The greater the number of improvements made in the construction of the former machines, and the more deeply our scientific investigators penetrate into the secret of this subtle force, the less remote will be the time when the transmission of motive power, light, and heat, will triumph over its greatest enemy—distance.

FIG. 1.



While recently many minds have been at work with more or less of success to produce improvements in dynamo-generators of electric energy, a very few have given their special care and attention to the development of the electro-motor. Experience has taught us hitherto that the efficiencies of one and the same machine for action and reaction, or for use either as a generator or by the inverted process as an electro-motor, stand in a certain and direct proportion to each other, or that our most efficient generators, such as the Siemens', Brush, and Gramme machines, prove also the most effective motors; and, on the other hand, that inferior dynamo machines invariably are inefficient motors. It would, however, be hazardous to conclude from the results of the researches I have recently made that the motors which are to supersede those now in use could not be employed as generators. Dynamo machines, such as now constructed, only prove efficient when their field magnets are able to retain at all times (*e.g.*, even when the machine stands at rest) a certain and very considerable amount of residual magnetism, and for that reason their cores are made of retentive material, hard cast iron, as is the case in the Brush and Gramme machines; or, if the cores consist of soft iron, they are attached to large masses of hard cast iron, in such a manner that the latter are enclosed in the magnetic circuit and form part of the cores.

FIG. 2.



Generators of the same kind, when made small in size, have cores much larger and heavier in proportion, and, moreover, the base plate, or, as in the Weston machine, a heavy retentive cylinder is made to form a portion of the field magnets. But all effort hitherto made to produce efficient small dynamo machines, with cores of soft iron only, have resulted in absolute

* A paper read at the late meeting of the British Association.

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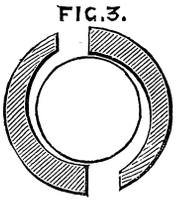
failure, although men of the highest genius have made repeated and prolonged efforts to solve that most difficult of problems.

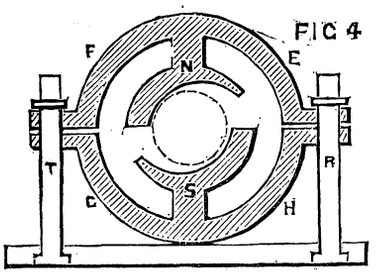
These curious facts conclusively prove that the theory explanatory of the action of dynamo machines, as now universally adoped, viz., the theory of inductive action and re-action between the field magnets and the armature cannot any longer be considered complete or satisfactory; for even wrought iron, especially when occurring in large masses, always contains an appreciable amount of residual magnetism, more especially after it has once been subjected to strong magnetisation; and if the above theory were correct and complete, then the smallest possible amount of residual magnetic energy, augmented by repeated action and re-action, would be sufficient for the starting of such a machine to action. This, however, experience proves *not* to be the case, and the theory, although stoutly adhered to, must be either abandoned or amended.

FIG.3.



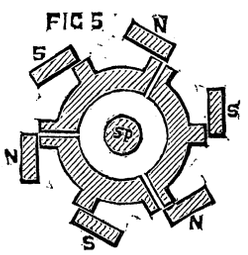
The inventors of the most recent electromotive engines have worked—perhaps, unconsciously—upon the idea that the construction and action of electro-motors are based altogether upon the same laws as those of dynamo r magneto machines, and, in accordance with that assumption, the field magnets of the Desprez motor are made to consist of large and heavy masses of magnetised steel.

FIG 4



Experimenters have also for a long time past clung to the idea that the efficiency of an electro-motor, or the amount of energy to be obtained from such a machine, by means of a current of given strength circulating in the coils of its armature only, bears a definite and direct proportion to the magneto-inductive power of its field magnets, and that an increase of power in the field magnets alone must necessarily produce greater capabilities of the machine.

FIG 5



This is a mischievous theory, because erroneous in some principles, and development would only lead to the hypothesis of perpetual motion. On the contrary, starting from a consideration of the fact that a very small magnetic needle, if acted upon by one of the poles of another and very powerful magnet, has its polarity destroyed or reversed, and that if one of its poles, say the N pole, is presented to a similar (N) pole of the large magnet, the former will completely lose its characteristic qualities, and be attracted by its overpowering opponent, we can only come to the one natural conclusion, that the power of the field magnets of an electro-motor, as compared to that of the magnet or magnets constituting its armatures, should not surpass the limit of some certain ratio, to be determined by experiments carefully conducted, and that, if it surpasses that limit, the capabilities of the machine must be impaired. Acting on this principle, I have constructed a motor in which the power of the field magnets is as nearly as possible equal to that of the armature, the core of the former being very light and made entirely of soft iron, and the satisfactory results I obtained from this machine are a sure sign that further investigation of the subject and experiments made, with a view of determining the exact ratio of power between the magnets and armature, will result in further improvement.

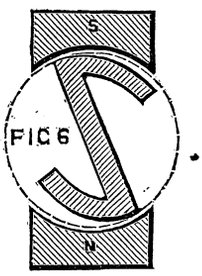
Another and very important consideration in the construction of dynamo machines and electro-motors has not yet received that care and attention from scientific investigators which would lead to immediate progress. It is the method of motion of the revolving armature with regard to its approaching to or receding from the poles of the field magnets. In nearly all the machines now constructed, the polar faces of the cores of the field magnets, and those of the armature, are of such a shape, and the latter is caused to revolve in such a manner, that only in a small portion of the revolution its poles either approach the poles of the field magnets, or recede from them. But the most successful production of induced currents will be achieved, and the greatest amount of power will be derived from a motor, if attention is paid, not merely to the *one* condition, that the armature should revolve in the most highly concentrated field possible, but also that nearly the entire motion of the revolving armature should be either one of approach or of withdrawal.

Let us first of all consider the case of a machine with two poles only of field magnets, and two poles of the revolving armature.

It is usual to give the active *facial* of the former such a shape that a section of the same represents a portion of a true circle. (See Fig. 1.)

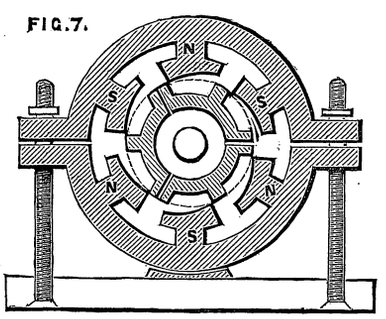
In the ordinary machines now in use, the radius of the circle described by the outline of the revolving armature, and that of the larger circle described in portion by the section of the inner or active *facial* of the poles, are nearly the same, and the two circles are concentric. (See Fig. 1.) The pole g of the armature only approaches the pole A of the field magnets while moving from c to d, or where the intensity of the magnetic field of A is at its minimum. When continuing its motion from d to r and to f, the pole g can no longer be said to approach A, because the distance between the respective surfaces remains constant.

FIG 6



I, therefore, propose that the device shown in Figs. 2 and 3 should be adopted. The radius of the circle, part of which is formed by the section $d\ r\ c$, is considerably larger than that of the circle described by the outline of the field of motion of the armature $d\ r\ c$, is, moreover, considerably less than the half of a circle, and the three circles $d\ r\ c$, f, $c\ h$, and that described by the outline of the field of motion of the armature, are not concentric. The pole g of the armature when in motion approaches the pole A, not only in its course from e to c, but also when in the most intense magnetic field of A, viz., whilst moving from C to z and d. Fig. 4 represents a section of the field magnets, cores E F and G H, and pole-pieces N and S, cast in two halves, and mounted on a base-board, to which they are fixed by the two bolts R and T. The same principles may be applied to machines with field-magnets of more than two poles (see Fig. 5), or the armature itself may be made of such a shape as to work under the conditions above stated. Fig. 6. But even if the poles of the armature and those of the field magnets are one of the ordinary shape, a machine with many magnets will be more perfect in its action than one with field magnets of two poles only. Fig. 7 illustates a machine in which the armature during nearly the whole of its motion either approaches to or recedes from the poles of the field magnets. In such machines the motion of the poles of the armature is also more in a line coincident with the line of attraction as exercised between the two systems of poles, while in machines with field magnets of two poles only the motion of the poles of the armature is at times at angles of 45 degrees to 1 degree from the direct pull.

FIG.7.



I may, perhaps, be allowed to call attention to another matter of importance awaiting further research. We find that in the three types of dynamo machines, as constructed by Siemens, Gramme, and Wilde, the relative positions of the axes of the field magnets and those of the armatures are altogether different. Yet the three systems work well. We are unable, however, to state with certainty which positions of the axis are the best, or why any one of these positions should be better than the others, and in the face of experience, the theory of tubes or lines of force is little more than a hypothesis with all its diffusion, vagueness, and uncertainty.

Having so far considered general principles chiefly, I now describe this motor (Fig. 8). A B C D is a wooden base board, E F G H a frame, consisting of the two parallel round rods F E and G H, and the two flat bars F G and E H made of the best wrought iron and carefully softened. The four bars are screwed together at the corners and supported by four brass brackets over the base-board. These four iron rods form the compound core of the field magnets, a combination, as it were, of two horse-shoe magnets, whose similar poles, S S and N N, form the junctions. Thus we have practically two poles only, a S and a N pole. Six coils of insulated copper wire are wound over the different portions of this core, shown in the drawing; the active pole-pieces are left exposed for a long distance, bearing no coils. The spindle, T L, which carries a Siemens armature of the old form, or an armature with a compressed tubular core, the commutator and pulley, traverses the flat cross-bar, F H. The core of the armature is made of sheets of charcoal-iron, and it bears a coil of stout insulated copper wire. The commutator is of the ordinary kind, consisting of two half-tubes of brass insulated from each

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Stationed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,321	220	A. Hyde	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	Lisbon.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Silvertown.
Telegraph Construction	ss Edinburgh	2,330	275	Seymour	Norway.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	E. Coast of Africa.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	Killett	Norway.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miguelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Syra.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	Cato	London.
Telegraph Construction	ss Seine	3,579	500	Manning	London.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	——	Dover.
H.M. Indian Government	Patrick Steward	1,130	130	A. W. Stiffe	Persian Gulf.

* This vessel sails under the French flag.

other and from the spindle, and each forming one of the terminals of the coil. Other diagrams were referred to, showing a sectional view of a compound machine and a view of the two end-castings which hold the field magnet, acting on the same principles. This machine contains a system of six field magnets and six poles, and a compound armature with six poles. The current is to be reversed six times for each revolution, and to accomplish this I have devised the following commutator. In these machines also the poles of the field magnets or those of the armature may be of such a shape as to be nearly always approaching to or receding from each other while in active motion.

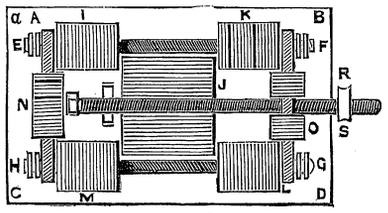

FIG. 8

The development of most important machines is destined to reach a certain stage of perfection when further improvements cannot be accomplished by the inventor unaided; the second and important factor needed, then, is the co-operation of inventive and investigative talent with capital. This stage of perfection has been reached in the steam engine, gas engines, printing machinery, &c., and it may be said to be rapidly approached by the progress made in dynamo machines and electro-motors.

The development of the latter machines is followed by the scientific world with greater interest, and it evokes more eager expectations than that of other machinery, chiefly because it is not and cannot be identified with the solution of a problem limited within the confines of mechanical difficulties and commercial interests; but it necessitates a further and deeper investigation into that great and subtle power — electricity — whose manifestations are so striking in their effects, so mysterious in their nature, so promising of great results in an immediate future, so fertile a field of research to the pioneer of science. Combined with this is the interest which of necessity must be attached to the efforts at the solution of a national problem, nay, one of international and universal moment, and one at which our ever-active Transatlantic kinsmen have worked to so great credit. Who will be the winner in this meritorious competition? Of higher moment even than the answer to this question ever can be is the consideration that by the work done in trying to solve the great problem new efforts will be made in scientific research, new principles discovered, new inventions made, and more light will be thrown over fields of intellectual work hidden, even now, in darkness, doubt, and mystery.

ABSTRACT OF PATENTS.

4916. Compositions for Insulating Telegraph Wires, Cables &c., *J. C. Mewburn.—Dated 10th December*, 1879.—*(A communication.)*—*(Not proceeded with.)* 2*d*.

The composition consists of 50lb. natural asphaltum, 30lb. resin, 10lb. bees' wax, 10lb. caoutchouc, and 10 gallons of linseed oil or driers, 12lb. litharge, 15lb. of manganese, 5lb. borax, and 5lb. lime. For protecting from the carbonising and destructive influence of the heat developed by the transmission of the electric current or fluid, 40lb. powdered asbestos and 18lb. powdered alum. The pipes containing the wires are filled with a composition consisting of 60 gallons of dead oil, 40lb. caoutchouc, 1,120lb. natura asphaltum, 320lb. powdered asbestos, and 150lb. powdered alum.

4903. Telephones, *C. E. Scribner.—Dated 29th November*, 1879.—*(Partly a communication.)* 8*d*.

This relates partly to a knife-like block with its blade completing the connection of the subscriber's line through the indicator to earth, and breaking this connection when the blade part is displaced by the application of the flexible connector.

4948. Electrical Signals for Railways, *J. J. Conklin, jun.—Dated 3rd December*, 1879. 6*d*.

An electro-magnet is employed and an armature with a lever, and a shaft that receives a quarter rotation in one direction by the armature lever acting against a projecting pin on the signal shaft. A latch holds the signal when thus turned, and a spring pusher that is acted upon by the armature when next moved by the electro-magnet unlatches the signal shaft, and allows a spring to turn it back to the normal position of safety.

4967. Pneumatic and Electric Signalling Apparatus, *J. and S Clark.—Dated 4th December*, 1879. *(Not proceeded with.)* 4*d*.

In one pneumatic arrangement for acting directly on a bell the receiving rubber cup raises a toothed rack which gears with a pinion on the same arbor as a spur wheel, the arbor being in vertically elongated slot bearings. When the rack rises it lifts up the pinion and spur wheel so as to make the latter gear with a pinion, or an arbor having on it a rotating striker which acts on the bell.

5045. Inclinatoriums or Dipping Azimuth Compasses, *J. Imray.—Dated 9th December*, 1879.—(*A communication.*) 6*d*.

The essential parts contained in the apparatus are, first, a dipping needle suspended on gimbals; secondly, an azimuth circle arranged concentric with the vertical axis, of rotation of the dipping needle, and provided with divisions corresponding to the points of the compass; and, thirdly, a regulator of the inclination.

5078. Electrical Signal Apparatus, *W. R. Lake.—Dated 11th December*, 1879.—(*A communication.*) 6*d*.

A pendulum is hung as the armature of an electro-magnet in connection with a device for automatically making and breaking the circuit to which the electro-magnet belongs, at intervals corresponding to the rate of vibration of the pendulum. A series of pendulums of different lengths are employed in connection with a series of electro-magnets in a common circuit, and a suitable device for automatically making and breaking the circuit at intervals corresponding to the rate of vibration of either pendulum. Two pendulums vibrating in equal times are employed, one hung as the armature of an electro-magnet, and the other operating a circuit closer to make and break the circuit containing the electro-magnet at each vibration.

TRAFFIC RECEIPTS FOR AUGUST, 1880.

Companies.	Aug., 1880.	Aug., 1879.	Incrse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,000 estd.	2,557	—	557
Direct Spanish Telegraph Company	1,197	996	201	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,988	36,257	6,731	—
Eastern Extension Telegraph Company	30,249	26,242	4,007	—
Great Northern Telegraph Company	22,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 8.		Business Done Week Ending Sept. 8. Highest.	Lowest.
Anglo-American Ordinary	65¼, ⅜		66⅜	65⅜
Do. "B"	96½, ¾		97⅓	96⅜
Do. "A"	36½, ¾		37⅜	36⅜
Brazilian	9 1-16, 3-16		9 3-16	9 1-16
Cuba	9⅛, ¾		9¼	9⅛
Do. Ten per Cent. Pref.	16½, 17		—	—
Direct Spanish	1⅝, 2¼		—	—
Do. Ten per Cent. Preference	11¾, 12½		12⅛	12
Direct United States	12⅜, ½		12¾	12⅝
Eastern	9 13-16, 15-16		10	9 13-16
Do. Six per Cent. Debenture	106, 108		106½	106½
Do. Five per Ct. do. 1899	103, 106		103½	103½
Do. Six p Ct. Pref.	12⅜, 13		12¾	12⅝
Eastern Extension	9⅜, 10		10	9¾
Do. Six per Ct. Deb	106, 109		107½	107½
German Union	9, ½		9½	9¼
Globe Telegraph & Trust	6 13-16, 15-16		6 15-16	6⅝
Do. Six p Ct. Preference	12 5-16, 7-16		12⅜	12¼
Great Northern	10, ¼		10¼	10⅛
Indo-European	24½, 25		25	25
Mediterranean Extension	2⅞, 3¼		3⅛	3⅛
Do. Eight per Cent. Preference	10⅞, 11¼		—	—
Reuter's	9½, 10½		—	—
Submarine	241, 247		244	241
West India and Panama	1⅛, ⅝		1 9-16	1 9-16
Do. Six per Cent. 1st Preference	7⅜, ⅝		7⅝	7½
Western and Brazilian	7½, ⅝		7⅝	7⅝
West. Union 7 p. Ct. 1st Mt.	120, 125		—	—
Do. Six per Ct. Sterg.	102, 104		—	—

ADDRESSES.

*** NOTICE.—It has been decided to devote a portion of the advertising space of *The Electrician* to giving the addresses and specialities of the principal firms of Electricians, Engineers, &c. A moderate charge per annum will be made for the insertion of such addresses weekly, and firms desirous to be included in the list are requested to apply to the Manager, 396, Strand. The addresses must not occupy more than five lines.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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,, 2. Dynamo-Electric Machines.
,, 3. Electric Lamps and Carbons.
,, 4. Photometers especially applicable to Electric Light Measurement.
,, 5. Miscellaneous Electrical Apparatus for Sale.

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Will on and after the 1st May, 1880, REMOVE to
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TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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SLIP

THUNDERSTORMS.—The abstract of a lecture by Professor Tait on this subject has been published in our excellent contemporary, *Nature*.

FEMALE TELEGRAPH CLERKS.—We understand that the Post Office authorities are again taking on girls as operators in the postal telegraph service.

ELECTRIC DISCHARGE IN RAREFIED GASES.—The current number of the *Phil. Mag.* contains a lengthy paper on this subject by Dr. Eugene Goldstein.

JAMAICA.—Complaint has been made of the insufficiency of public news communicated by the Telegraph Company which receives a subsidy of £2,000 per annum.

COMMUNICATION WITH CANDAHAR.—The telegraph line to Quettah being now in working order, telegrams can be forwarded from that place by post as far as Candahar.

LIGHT, ELECTRICITY AND SOUND.—In another page we give Professor Bell's paper, read at the late meeting of the American Association for the Advancement of Science.

PERSONAL.—Mr. Cracknell, superintendent of telegraphs in Queensland, who has recently visited England, will, we understand, retire on a pension of £300, and will settle in Australia.

COAD'S BATTERY.—We understand that arrangements are being made for early and extensive experiments with the electric light having this battery as the motor. Mr. A. Shipping, of King-street, Cheapside, has the matter in hand.

LARGE ORDER FOR TELEGRAPH WIRE.—Messrs. William Cooke and Co. (Limited), of Sheffield, have just secured the largest Government order for telegraph wire that has been given out for many years. The order amounts to about £20,000, and the wire is intended for telegraph purposes in India.

ACADEMY OF SCIENCES.—At the sitting on August 16 MM. Jacques and Currie read a paper on "Polar Electricity in Hemihedric Crystals with Inclined Faces," and showed that in all the non-conducting substances studied the direction of the electric poles is connected with the position of the hemihedric facettes.

THE GRANTS AT THE BRITISH ASSOCIATION.—The following grants were made at the late meeting to further experiments in relation to electrical subjects:—To Professor G. C. Foster, £100, subject, Electrical Standards; to Dr. O. J. Lodge, £5, subject, High Insulation Key; to Mr. J. M. Thomson, £10, subject, Inductive Capacity of Crystals and Paraffin.

THE TELEPHONE COMPANY AND POPLAR LOCAL AUTHORITY.—An application was received by the Board from the United Telephone Company for permission to erect two poles in the Recreation Ground. The Chairman remarked that the Board would have to look carefully into this matter before agreeing to it. The application was referred to the Poplar Committee.

ELECTRICAL TARGETS.—A correspondent writes, with reference to the Wimbledon marking scandal, asking whether an electrical automatic recording target has never yet been devised. We have heard of some such device; and certainly the construction of an electrical system for this purpose would be by no means difficult. It does not appear, however, that anything of the kind has yet secured the patronage of the National Rifle Association.

NEW ZEALAND.—Retrenchment is the subject that has occupied most attention lately. The Government have decided to reduce the salaries of all their *employés* by 10 per cent., and to economise still further by dispensing with whatever may be regarded as "luxuries," such as grants to Botanical Gardens, and so on, by the amalgamation of offices where practicable, such as the telegraph and postal departments, and by the discharge of all officers whose services can be spared.

BRIGHT'S ELECTRIC FIRE DETECTOR.—The North Shore Flour Mills of Liverpool are now fitted with this ingenious mode of detecting fires. The system is the one under experiment over a large area in the City of London and Southwark, the fire at the Daniel Lambert Tavern on Saturday, the 28th ult., having been signalled by the apparatus. The North Shore Milling Company have also, it is stated, given an order for thirty electric lamps to be placed in different parts of their establishment.

THE ELECTRIC LIGHT IN THEATRES.—*La Nature* contains a letter from M. E. Vignes, insisting upon the advantages of introducing the electric light into the interior of theatres. The writer looks forward to the time when the cheerful illumination to be seen on the *place de l'Opéra* will be extended to the interior of the edifice itself, and when the hygienic and æsthetic advantages of the electric light, together with the immunity it affords from explosions and fire, will be secured not only for the great Temple of Music, but also for the smaller theatres, where a heated and vitiated air is now breathed, and where the attempt at ventilation is often a mortal danger.

DISTINGUISHING THE VOICE THROUGH THE TELEPHONE.—Mr. W. Dowling writing to Messrs. Moseley and Sons, Telegraph Engineers, Manchester, says:—I have a high opinion of your telephone, and have to thank you for permitting a test of its capabilities to take place at my house a short time since. Perhaps the most striking illustration of the faithfulness with which the voice is conveyed by your wonderful instrument was afforded by my wife's little terrier, who, on hearing its mistress's voice applied to the telephone in a distant room, connected with the room (in which was the dog) by your wire communication, instantly pricked up its ears, and made an attempt to jump into the mouthpiece in order to get to its mistress—an impartial, unerring testimony to the thoroughness of the apparatus.

THE GOWER-BELL TELEPHONE COMPANY (LIMITED).—This company, with a capital of £200,000, in shares of £10, has been formed for the purpose of manufacturing, laying down, buying, selling, letting out, maintaining, repairing, working, and generally dealing in telephones, telegraphic instruments, telephone and telegraph lines, and all instruments, lines, and other apparatus connected with any of the foregoing particulars. Acquiring, using, and exercising any patents, copyrights, grants, concessions, or privileges which may be desirable for any of the objects of the company. The subscribers are: F. A. Gower, 9, Great Winchester-street, 20; A. Scott, 223, Gresham House, 1; C. J. Wollaston, 223, Gresham House, 1; A. F. St. George, Red Hill, 1; G Clements, 17, Gresham House, 1; W. T. Edmonds, Sutton, 1; J. M. Williams, 17, Gresham House, 1.

MEDICAL ELECTRICITY.—THE CONSTANT CURRENT IN INTESTINAL OCCLUSION.—Two cases in which the employment of electricity was eminently successful are reported by Dr. Boudet in the *Progrès Médical*, and are referred to in some detail by the *Medical Press and Circular* for September 1 last. In both cases the constant current from a Gaiffe's peroxide of manganese battery of 6 (increased to 10 or 14)

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cells was used. The applications, 10 in the first and 8 in the second case, varied in duration from half-an-hour to an hour or an hour and a-half each, but were not made continuously. Contact was established for one second at a time at intervals of about half a minute; each closure of the current produced a violent intestinal contraction. The induced, instead of the constant, current was tried, but it provoked intolerable pain and seemed to act only on the muscles of the parieties.

Atlantic Cables.—The Anglo-American Company has now in operation four cables (including the new cable completed the 21st August last.—Ed. *E.*), and the Direct United States one, which, by the successful application of the duplex system in working them, afford facilities equal to what would have been realised with ten worked in the ordinary way. It is expected that these will adequately meet the demands of the public for some time to come. Should more be required, however, the managers of the Anglo-American and Direct Companies are prepared to supply them promptly, each company having wisely accumulated a large reserve fund for maintenance of existing cables, and providing new ones as required. The efforts of the cable companies are liberally seconded by the Western Union Company, which is now engaged in building an entirely new line of the largest wire used for telegraphic purposes, which is to be quadruplexed and used exclusively for cable business.—*Journal of the Telegraph.*

Telephone and Telegraph Wires.—Mr. Morrison, at the last meeting of the Commissioners of Sewers for the City of London, called attention to the enormous and increasing number of wires that were being carried over the tops of the houses in the City. In Leadenhall-street alone there were over 900 of these wires, and unless some supervision was exercised there might be some very serious accident. He desired to know if the Commission had any power in the matter, because it was undoubtedly a source of danger, and if the Court had not the necessary power he should like to know that some other body had. The Chairman: I understand that it is a Government question, and that the Government have full authority to place telegraph wires wherever they think fit. Mr. Morrison: I am told that the increased number of wires arises not so much from the telegraph as from the development of the telephone system. Have we any power in regard to those wires? The Chairman: As to that I cannot say. Mr. Morrison moved that the question be referred to the Finance and Improvement Committee for inquiry and report, and the motion was carried.

Fires and Overhead Wires.—A correspondent sends us the following extract from the *Manchester Evening Mail* of Sept. 13, 1880, which touches on a subject we have continually drawn attention to.—"On Saturday night, a fire attended by rather serious consequences occurred at the works of Messrs. Whittaker, starch manufacturers, Midland-street, Ashton Old-road, Manchester. The fire broke out at about 11 o'clock, and an alarm was given at the chief fire station soon afterwards. Mr. Tozer and the brigade were promptly in attendance. On their arrival it was found that the premises, which were four storeys in height, and 100ft. long by 40ft. wide, were in flames. Eight jets were speedily attached to the mains, and the steam fire-engine was brought into operation with good effect. The building faces Midland-street, and two narrow streets run along each side of it, while at the rear is a brewery also belonging to Messrs. Whittaker. Owing to the well-directed and strenuous exertions of the brigade, the conflagration was prevented from spreading to the adjoining buildings, and in about two hours the fire was subdued. The building and its contents were seriously damaged. The cause of the fire could not be ascertained. As the fire escape from the Ardwick Green fire station was being taken to the fire it came in contact with a private telegraph wire, which was attached to the chimney-stack of a cottage in the occupation of a working man named Muddyman, 16, Yarwood-buildings, Midland-street. So violent was the contact that a portion of the chimney stack was pulled down and dashed through the roof into a bedroom in which three children were sleeping. The children, fortunately, were not injured, but, as might well be imagined, they were greatly terrified, as were their parents and the neighbours who heard the crash. The escape of the children seems to have been most providential, as the *débris* lay scattered all round the room. No blame is to be attached to the men who were in charge of the escape. The street is narrow, and at the place where the accident happened it was very dark, and the men could not see the wire. The wire was the property of of Messrs. D. Moseley and Sons, of Manchester."

A Big Experiment in Electric Lighting.—The *Paper World*, published at Holyoke, announces that that city is to be the scene of an extensive experiment in the use of the electric light. H. C. Spaulding, of Boston, who was at first going to put his plans into effect in this city, has gone to Holyoke on account of cheap power, and has made arrangements with the Water Power Company to put a wheel into their new pit near Cabot-street expressly for his use. To make the experiment which he will attempt will require 150 horse-powers, or over two mill-powers, or enough to run a paper mill. A tower about 75 feet high will be built, and surmounted by an immense lantern of such power as to put all former electric lights completely in the shade. Mr. Spaulding will put up his power and apparatus at his own expense, but he hopes to succeed so well that the city will adopt the system. He is extremely enthusiastic and sanguine as to the results of the experiment, and his expectations go far beyond the achievements of any previous electrician. He says that with seven such towers as he intends to build he can make the entire city as light as day, both indoor and out. His idea is that by filling the atmosphere above the city with light, he will get the same effect that we do from the sun and its reflected light, and that the shadows will be no darker than those made by the sun. His idea is to fill the stratum of atmosphere just above the city so completely with light that it will permeate spaces which no direct rays reach, just as the sun's light does immediately after the sun has set. The light which he expects to throw out from one lantern will be equal to 300,000 candles, while the largest electric light yet attempted by any one else has been of but 10,000 candle-power. The apparatus will cost 15,000 dollars, irrespective of any investment for power, but after the system is once in operation the cost of running it, aside from the power, will be small. The expense of lighting Holyoke at present, public and private, is estimated at 100,000 dollars a year, and for about that amount the seven towers which are proposed could be set up, and the lights put in operation.—*Boston Herald.*

City and Guilds Institute.—Besides the course indicated in our last issue, Professor Ayrton will, in that on "Weighing Appliances and Motor Machinery," discuss the following electrical subjects:—Magneto and Dynamo-Electric Engines: Heat of combustion of various fuels available for heat and electric engines. Measurement of electric energy. Conversion of electric into mechanical energy. Every electro motor is also a generator of

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electricity. Measurement of the efficiency of electric generators and of electro motors, results of actual experiments. Great superiority in efficiency as compared with existing heat engines. Transmission of Power: By belting, water, compressed air, and electricity. Practical methods already employed. Relative efficiency of the various arrangements, superior efficiency of electric transmission. Electric railways, tramways, ploughing, &c. Increase of efficiency with high speeds and small electric currents. Relative suitability of the Gramme, Siemens, and other machines for electric transmission of power. How the efficiency now obtained may be practically increased, &c. Besides the above, Professor Ayrton will give a series of day lectures on the electric light, of which the following syllabus has been issued:—Heat produced by an electric current. Meaning of an electric current and of the direction of flow. Current is proportional to chemical decomposition. Meaning of resistance, resistance is proportional to square of the heat produced. Analogy and want of analogy of an electric current with a stream of water. Incandescence. Loss of heat by conduction, radiation, and convection. Vacuum lamps. Ohm's laws. Electromotive force. Current and electromotive force necessary to maintain a given conductor at a given temperature. The electric arc. Opposing electromotive force set up in arc. Electric lamps, principles of the most important, Foucault's, Serrin's, Duboscq's, Siemens', &c. Electric candles, Werdermann's, Jablochkoff's. Combination of lighting by arc and by incandescence, Werdermann's, &c., &c.

New South Wales.—The following return shows the extent of the electric telegraph lines of this colony during the year 1879:—Extent of electric telegraph line wire in actual use on December 31, 12,426 miles 16 chains 3 links; number of electric telegraph stations on December 31, 273; number of telegraph messages transmitted during the year, 1,175,218; total revenue of electric telegraph department for the year, £80,490 0s. 6d.; total expenditure of electric telegraph department for the year, exclusive of interest on cost of construction of lines, £103,923 0s. 2d.

Electrolytic Estimation of Cobalt, Nickel, and Copper.—After enumerating the sources of error and inconvenience in the estimation of these metals by any but the electrolytic process, the author describes his method of procedure. The current was produced by a small Gramme machine, the rate of revolution of which was under control, a moderate speed producing a current which caused a deflection of 70° on an interposed sine-compass. When nickel is to be deposited in the presence of little or no cobalt, a very strong current is necessary, but if the quantity of cobalt is large, a weaker current must be employed to secure a firmly adherent deposit. Copper may be separated by means of a very strong current if it does not exceed 400 mgms. in weight. The metal should be deposited on a platinum cone formed by rivetting the parts together, any folding together or curving of the edges being avoided as they tend to retain the metallic deposit. As an example of the application of the electrolytic process, the analysis of a cobalt-nickel ore is given. After decomposing the ore by treating it with strong nitric acid or aqua regia, preceded, if necessary, by fusion with sodium carbonate, the solution is evaporated to dryness; the residue is then dissolved in a little strong hydrochloric acid diluted, and sulphuretted hydrogen passed through the hot solution until it is cold; the passage of the gas through the hot solution should be repeated, when all arsenic and copper present will settle rapidly as sulphides. If, by the colour of the precipitate, copper is judged to be absent, the excess of sulphuretted hydrogen should be removed by heat before filtering, since arsenic sulphide is somewhat soluble in a solution of this gas. If copper sulphide is present, the removal of the gas is omitted, and a slight error arises from the arsenic sulphide present in the filtrate. The filtrate is evaporated with addition of the potassic chlorate to oxidise the iron; the residue is taken up with dilute hydrochloric acid; soda is then added to alkaline reaction, and the precipitate dissolved by addition of acetic acid; the liquid is then diluted and heated to boiling to precipitate the iron. The filtrate from the iron is evaporated to dryness, and the residue dissolved in water and dilute sulphuric acid, mixed with excess of ammonia, and subjected to electrolysis. As soon as the liquid has been free from colour for some time, and a few drops yield no precipitate or dark colouration with ammonium sulphide, the platinum cone with the deposit of nickel and cobalt is removed, washed with water, then with absolute alcohol, dried, by holding it over a heated surface, and weighed. The nickel is then estimated in the dry way by Plattner's method, and the cobalt found by difference. The method of estimating the nickel is liable to an error of only 0·2 per cent. The alternative plan is to dissolve the electrolytic deposit in dilute nitric acid, and separate the cobalt with potassium nitrite. The precipitate of basic ferric acetate is free from nickel and cobalt, or contains mere traces of those metals, and even if the iron should not be completely precipitated, a small amount of ferric hydrate precipitate present during electrolysis is harmless. The separation of nickel, cobalt, and copper from the solution of any substance is effected by passing sulphuretted hydrogen slowly into the cold solution, which has been freed from silicic acid, until the copper sulphide separates; the arsenic remains almost entirely in solution; the copper precipitate is filtered off rapidly, and with the filter is heated with nitric acid, then evaporated to dryness; the residue is dissolved in nitric acid, diluted, and the copper precipitated by electrolysis; any arsenic present separates after the copper; the current is, therefore, stopped when the copper is completely separated, and the solution, freed from nitric acid by evaporation, is mixed with the former filtrate, from which the arsenic is then precipitated as sulphide and estimated as ammonium magnesium arsenate. Iron, if present in any quantity, is precipitated as basic ferric acetate, and nickel and cobalt are then separated from the ammoniacal solution by electrolysis, any ferric hydrate precipitate which forms on addition of ammonia being added to the iron precipitate. The alkaline earths can be determined in the liquid from which the nickel and cobalt have been separated. Zinc is the only metal which need be separated before estimating nickel and cobalt. It must be separated by passing sulphuretted hydrogen into the acetic acid solution; the filtrate is evaporated, the residue dissolved in dilute sulphuric acid, and the ammoniacal solution is then electrolysed. Copper is separated from arsenic as described above; antimony should be removed by twice evaporating with nitric acid; and lead, if present in any quantity, should be precipitated as sulphate; traces of lead will not interfere, since the metal separates as peroxide on the positive pole. Silver is separated as chloride, and bismuth as basic chloride. The author's experience in the application of the electrolytic method to the quantitative analysis of metal ores leads him to recommend it on the grounds of economy of time and great accuracy.—*Chem. Soc. Jnl.*

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

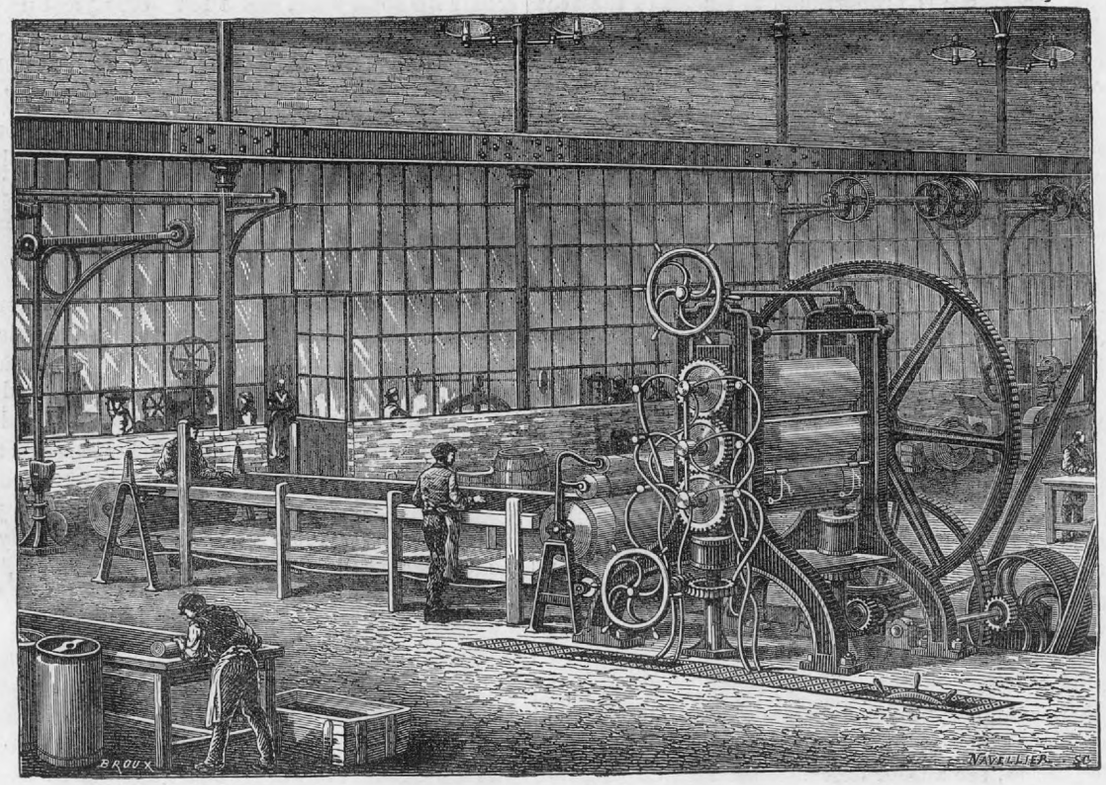
BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 197.)

LECTURE III.—DELIVERED FEBRUARY 16, 1880.

The calender consists of three large rollers, capable of being heated internally by means of steam, and mounted in a massive cast-iron frame. The drawing now projected on the screen (Fig. 17) will give you some idea of the nature of the apparatus, although some accessories are here represented which are not generally used in this country. The softened rubber is first passed between the top roller and the middle one; while the sheet thus formed adheres to the middle roller, and is brought between this and the bottom roller, where it becomes loosely attached to a cloth, which passes through

FIG. 17.



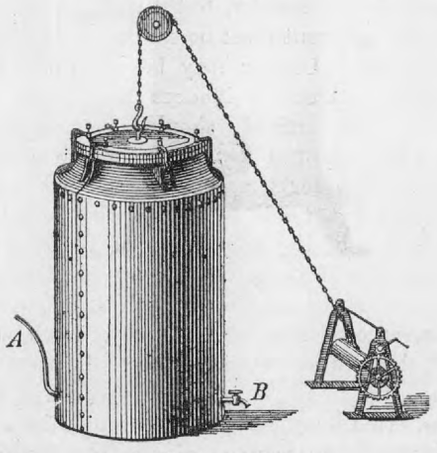
THE CALENDER, OR ROLLING MACHINE.

with it. In some cases a calendering machine with four rollers is employed, but it is questionable whether any proportionate advantage is gained. There are on the table some specimens of calendered sheets of various thicknesses, and I can very well illustrate the operation of rolling out the softened rubber by means of this small rolling machine. The soft sheets may be made to adhere together by merely bringing them in contact while warm, or by cementing them with a little of the mixed rubber dissolved in benzoline; and it is a very easy matter to make even extremely complex articles out of the material in question, as the mastication and mixing have so far detracted from its elasticity and toughness that it may be worked almost like putty provided that it is gently heated. This latter circumstance is more especially true of rubber, with which a considerable amount of any inert powder—such as clay, plaster, or oxide of zinc—has been incorporated. Although the rubber is so far degenerated by the masticating and mixing processes as to become plastic, and capable of being moulded with ease, it is merely necessary to expose it to a heat of 135° Centrigrade for two or three hours in order not only to restore the lost elasticity but to give it the enormously increased strength and elastic power due to vulcanisation. The operation of heating the mixed rubber in order to induce its reaction with the mixed sulphur is usually called "curing" the rubber. In most cases the heat of high-pressure steam or of water under the influence of high-pressure steam is employed for curing, as, in such cases, it is easy to ensure an equal temperature throughout; and, moreover, the rubber is protected from the action of the air. In some cases, however, it is more convenient to employ dry heat, as I shall explain to you in speaking of some of the special applications of india rubber.

The steam vessels, or vulcanisers, in which the operation of curing is performed, are constructed somewhat after the fashion of boilers, but are provided with large removable lids, in order that the goods may be placed in position and removed. These vulcanisers are in communication with the steam-supply pipes of the works, and are provided with pressure-gauges and thermometers, in order that those in charge may be enabled to regulate the in-flow of steam. Such a vulcaniser is now shown on the screen (Fig. 18), but it does not require any special explanation beyond that already given.

The next lantern slide (Fig. 19) which I have to show you represents the curing-shop or vulcan-house of a rubber works. You will notice the large vulcaniser near the middle of the apartment, and several small ones round about. The long, horizontally-placed vulcaniser—of which one end is shown towards the right hand side of the picture—represents the kind of vulcaniser ordinarily used for curing tubes, these tubes being laid in a long tray containing powdered French chalk.

FIG. 18.



A VULCANISER.

On the table, and round about it, are several small vulcanisers,

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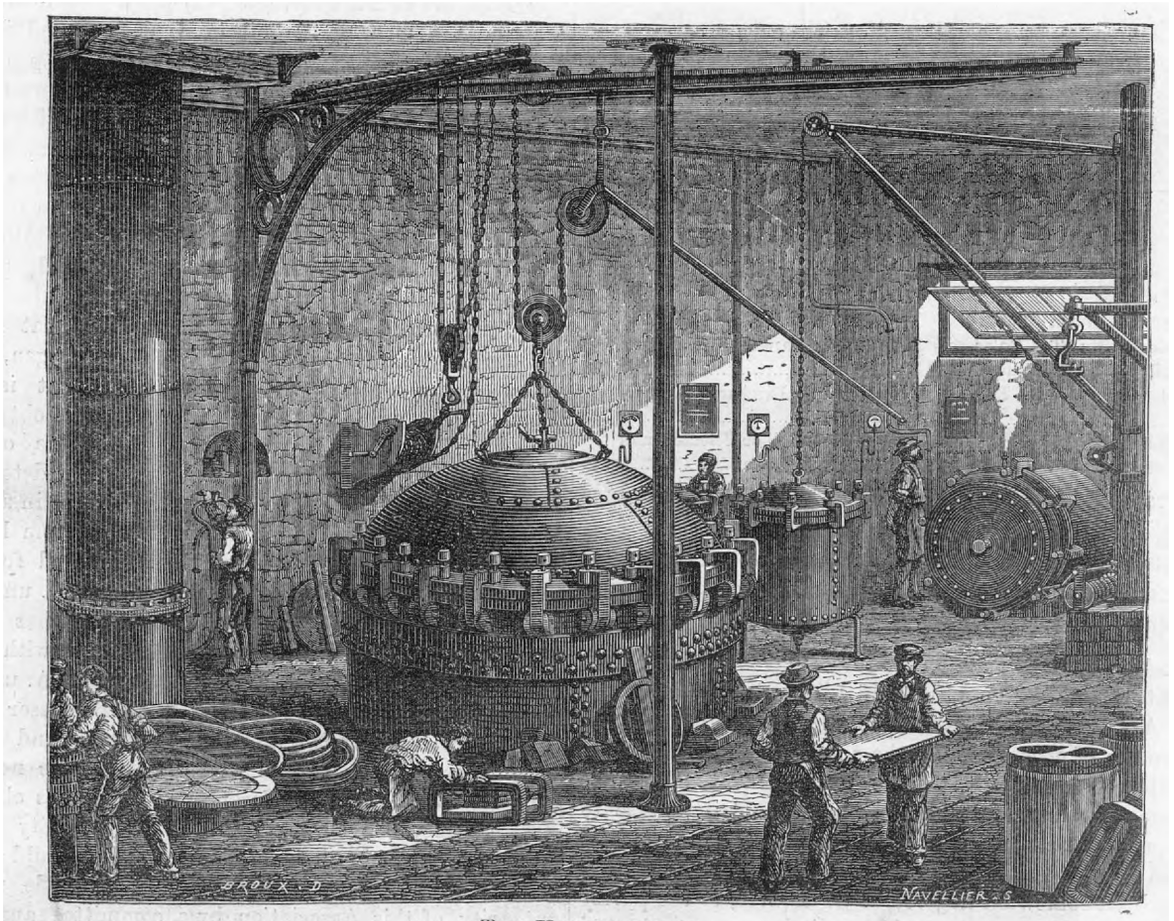
suited for experimental work. This one (Fig. 20), known as Child's, and manufactured for the use of dentists, by Messrs. Ash and Co., of Broad-street, Golden-square, being a very convenient apparatus. It consists of an iron boiler, provided with a lid, which carries a safety valve and an arrangement by which a thermometer can be so placed as to indicate the internal temperature. A little water being placed in the boiler, the articles to be vulcanised are supported over it, and the heat necessary for the generation of steam is produced by means of the gas burner. Messrs. Ash also construct still smaller vulcanisers, which are suited for use on the table of an ordinary room (Figs. 21 and 22).

Here is a very ingeniously-constructed apparatus, made by Mr. Walker, of Birmingham, in which the pressure-gauge is so connected with the gas supply that an undue increase of pressure reduces the amount of gas admitted to the burner; but it is scarcely necessary to say that an automatic arrangement of this kind does not altogether do away with the need of some kind of intelligent supervision during the use of the vulcaniser.

As before mentioned, it is a very usual practice to mix mineral and other matters with the rubber during the incorporation of the sulphur, and it sometimes happens that as much as 80 per per cent. of foreign matter is mixed with the rubber in this way. The presence of a large proportion of inert matter naturally detracts from the elasticity of both the mixed and the cured rubber, the former working almost like soft dough in the calendering machine, and this at a comparatively low temperature; while the cured rubber is hard, and comparatively inelastic. The presence of a considerable proportion of inert matter generally diminishes the length of time required for curing.

(TO BE CONTINUED

FIG. 19.



THE VULCAN-HOUSE.

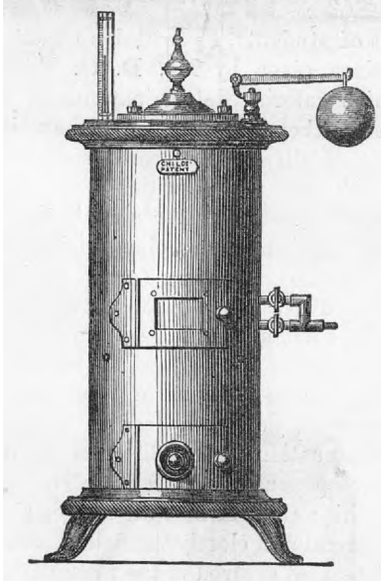


FIG. 20.

FIG. 21

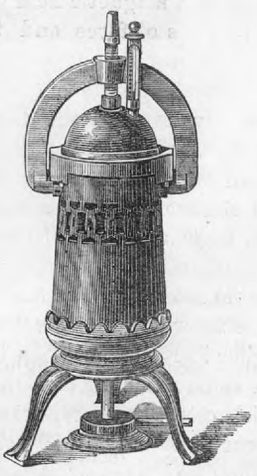


FIG. 22.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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ELECTRO-CHEMISTRY AND THE B.A. UNITS.

The address, at Swansea, of Professor Adams, the actual president of the Mathematical and Physical Section of the British Association, will not only have the effect of directing the attention of electricians to the question of the true theoretial value of the material units of measurement which have been generally adopted, but will probably contribute also to a more general recognition of the importance of a branch of electrical science—electro-chemistry—which for many years past has been somewhat neglected. Of course, to the purely practical man it is a matter of very little moment whether his B. A. unit or *ohm* be or be not precisely, at the temperature of melting ice, that resistance through which the electromotive force generated by a straight bar one metre long, moving across a magnetic field of unit intensity, perpendicularly to the lines of force and to its own direction, with a velocity of ten millions of metres, would produce a current capable of developing in one second the amount of heat that will raise by 1° Cent. the temperature of ·2405 gram. of water at its maximum density. But to the theoretical electrician, and even, we may say, to the intelligent student of electrical science, the true relation to the fundamental units of length, mass, and time of those material standards which he adopts as units of electrical measurement is a matter of considerable interest. Nor can he remain altogether satisfied when he is informed that his "ohm" is probably 1·5 to 2 per cent. higher in resistance than the abstract unit to which he gives the same name, or that the true electromotive force of the Daniell cell is probably 1·165 volts, although to him it may appear to be only 1·079 volts.

Doubtless, as Professor Adams observed, we are making rapid strides towards the exact determination of the relations, between the various modes of motion or forms of energy. There is a feeling, however, not only that the electrical questions involved in these relations have been left in too few hands, and have been insufficiently popularised, but also that certain great storehouses of very accurate data, such as the determinations by Andrews of the heat evolved during metallic precipitations, have not been duly utilised for the purposes in view. The electro-chemist, in fact, has left too much to the mathematical physicist, and has not taken his proper share of the work in hand. The following reference, by the above-mentioned authority, to some recent work based upon Faraday's laws, and the practical proposal by which it is followed, are therefore of special interest:—

"The laws of Faraday, that (1) when a compound is electrolysed the mass of the substance decomposed is proportional to the quantity of electricity which has produced the change, and that (2) the same current decomposes equivalent quantities of different substances, *i.e.*, quantities of their elements in the ratio of their combining numbers, have given rise to several determinations of the relation between chemical affinity and electromotive force. In a paper lately communicated to the Physical Society, Dr. Wright has discussed these several determinations, and has given an account of a new determination by himself. The results obtained are compared with the heat given out by the combustion of hydrogen and oxygen, and the value of the mechanical equivalent of heat is deduced from these determinations. The value obtained by Dr. Wright, which depends on the value of Clark's standard cell, agrees fairly well with Joule's determination from the heat produced by an electric current in a wire, but is greater than Joule's value as obtained from his water-friction experiments. This may be accounted for by supposing an error in the value of the ohm or B.A. unit, making it too large by 1·5 or 2 per cent. Kohlrausch has also made comparisons of the copies of the B.A. unit with standard coils, and comes to the conclusion that the B.A. unit is 1·96 per cent. too large. On the other hand, Professor Rowland, in America, has made a new determination, and finds that according to his calculations the B.A. unit is nearly 1 per cent. too small. These differences in the values obtained by different methods clearly point to the necessity for one or more new determinations of the unit, and I would venture to suggest that a discrimination should be made under the authority of this Association by a committee appointed to carry out the work."

For the benefit of students, we will here quote a simple example—long since given by Mr. D. G. FitzGerald—of the mode in which calorific determinations, in relation to chemical or electro-chemical reactions, may be utilised in the verification or disproof of conclusions based upon the results arrived at by the British Association Committee on electrical standards. As already mentioned, the B.A. unit current, traversing one ohm during one second, generates ·2405 calories of Dulong (grams of water raised through 1° Cent.). This, it is to be observed, is a datum involving not only the fundamental basis of the B.A. system, but also the mechanical equivalent of heat. Another datum, to be taken entirely on the authority of the Committee, is that the B.A. unit current, in its passage by a zinc anode, effects in one second the combination of ·000332 gram. of zinc with the electro-negative component of the electrolyte, or, in other words, consumes this weight of zinc in each cell. Our third datum is a very careful and closely verified determination by Dr. Andrews of the heat evolved in the precipitation of copper by zinc; one gram. of zinc thus substituted for copper, in combination with the acid radical SO_4, evolves 847 calories of Dulong. Now, this substitution of zinc for copper constitutes the whole and only electro-chemical reaction in the Daniell cell, and the consumption per second in this cell of the above-mentioned ·000332 gram. of zinc must, if this datum can be depended upon, be accompanied by the evolution of ·2802

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calories. Since the passage of unit current through unit resistance generates only ·2405 calories, it is obvious that a Daniell cell must be circuited through a resistance greater than one unit in order to produce the unit current which, whilst consuming ·000332 gram. of zinc in a single cell, will evolve ·2802 calories. In other words, it is obvious that the E.M.F. of a Daniell cell (necessarily equal to the resistance through which it will produce unit current) must be greater than 1 B. A. unit or volt. By Joule's law, the value $\frac{E^2}{R}$ is proportionate to the calorific effect; and, when $R = E$ (*i.e.*, when unit current is considered), the value in question is, of course, simply equivalent to E. We have then the proportion:—

·2405 calories : unit E.M.F. :: ·2802 cal. : the E.M.F. of Daniell's cell.

Thus, if the above date be accepted as accurate, it follows of necessity that the electromotive force of a Daniell cell must be $\frac{2802}{2405} = 1{\cdot}165$ volt, instead of 1·079 volt, which is the value most commonly accepted.

We will close this notice of that portion of Prof. Adams's address relating to electricity by drawing particular attention to the following observations, which tend in the direction of clearing up any uncertainty as to the value, within a very small percentage, of the practical unit of resistance to be finally adopted by electricians. Referring to his suggestion that a fresh determination should be made under the authority of the British Association, Prof. Adams says:—"It is not sufficient that this determination should be made once for all, for there is reason to think that the resistance of standard coils alters with time, even when the material has been carefully selected. It has been found that coils of platinum silver which were correct copies of the standard ohm have become so altered, and have their temperature coefficients so changed, that there are doubts as to the consistency of the standards themselves. Pieces of platinum-silver alloy cut from the same rod have been found to have different temperature co-efficients. The value ·031 for 1°C. is given by Matthiessen for this alloy, yet two pieces of wire drawn from the same rod have given, one ·021 per cent. and the other ·04 per cent. for 1° C. Possibly this irregularity in the platinum-silver alloys may be due to something analogous to the segregation which Mr. Roberts has found to take place in copper-silver alloys in their molten state, and which Matthiessen in 1860 regarded as mechanical mixtures of allotropic modifications of the alloy. A recommendation has been made that apparatus for determining the ohm should be set up in London, and that, periodically, determinations be made to test the electrical constancy of the metals and alloys used in making coils. A committee should be authorised to test coils and issue certificates of their accuracy, just as is done by the Kew Committee with regard to meteorological instruments."

CORRESPONDENCE.

EDISON'S ORE SEPARATOR.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Your usually well-considered editorial efforts are marred in your issue of the 14th, by a criticism on Mr. Edison's Ore Separator, in which you say it is "a contrivance which has again and again been shown to be no novelty; but few are aware how old it really is—at least, in idea." You cite a patent of 1792, as originating the separation of the magnetic constituents of ores, while in its title, which you quote, it only seems to seek to apply a fact which was known long before—viz., how to divide, by drawing to a magnet, such particles as are susceptible of attraction from those which are not. Let me add that there are at least twenty United States patents in existence on the same subject, and it would be an absurdity to suppose that Mr. Edison, who has one of the finest private scientific libraries in the world, with an enforced knowledge of patents and the laws governing them equalled by few, should not have been fully aware of all that has been done in this direction. A similar opinion to that you express was once held by the *Journal La Lumière Electrique*; but when all the references it gave as antecedent to Edison were looked into, they were found to be descriptive of mere devices for passing magnets through magnetic sands. A study of Edison's separator will show that it is entirely unlike, and far in advance of any previous inventions for that purpose. The difference between the methods might be compared to that of a man's direct lift and his bearing on the handle of a hydraulic engine that exerts a pressure of a thousand tons.

I will not deny that the energy exerted by the muscles may be the same in both cases, but in which do we see the greater work done?

Mr. Edison does not attempt to separate magnetic sands by wasting his force by moving his matter into contact with his magnets; he only influences it enough to draw it the least bit out of the line of direct fall—that is, the perpendicular—just enough to give ever so small a trajectory which it did not possess before.

To illustrate, let us imagine a body weighing a thousand tons suspended by a wire 4,000 miles long (the distance from the centre of the earth to the centre of the body), the wire representing, in this case, a force that balances the direct pull of gravity; the hand of an infant can deflect it from the perpendicular. Release the body; let it fall to earth, and a hundred horses will not move it. Now, Edison simply disturbs the free fall of a body in motion; all other inventors try to move the body from a state of rest, or to completely overcome its inertia while in motion. The first brings about what motion is necessary for a *perfect* separation (by altering the fall from a straight line to one slightly curved) with the minimum expenditure of force; while the latter does the same (for an *imperfect* separation) with a *maximum* outlay. A simple experiment, performed with a mixture of brass and iron filings, will show that any of the contact processes of separation do but imperfect work, for the magnetic particles, by an interlocking of their lines of force, entangle in their midst the non magnetic particles which touch them. This is not the case during a free fall of a mixture, since each particle moving according to its own specific gravity tends to a natural separation from its neighbour.

I trust, after due reconsideration, you will see the unintentional injustice you have done the great inventor, and remove the unfavourable impressions your remarks may have made on those who in such matters are guided by your judgment.—Yours, &c.,

OTTO A. MOSES.

229, Broadway, New York. P.O. Box 3,838, New York.

ON THE BEST FORM OF MAGNET FOR MAGNETIC MACHINES.*

BY W. LADD, ESQ.

At the British Association meeting at Dundee, in 1867, I made some remarks upon different forms of magnets, and exhibited these diagrams, showing by the "lines of force"—naturally arranged—the great superiority of the circular magnet where an armature is to be employed.

Since that time some thousands of that form of magnet have been made for medical, mining, and other purposes.

Some months ago, in conversation with M. Breguet, of Paris, I showed him these same diagrams, and he was very much impressed with their importance; he has since then constructed a machine, using the Gramme armature, and with a smaller quantity of steel in the magnets, he has made a far more powerful machine than hitherto constructed with either the Jamin or the ordinary horse-shoe form. It is also more symmetrical in appearance, and occupies less space.

With this machine I can heat to incandescence 19 inches of platinum wire by four turns of the handle, while to heat 14 inches of the same size wire by a machine having a Jamin magnet, it took ten turns of the handle.

* Read at the British Association, Friday, August 27.

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THE EARTH AS A CONDUCTOR OF ELECTRICITY.

An interesting study of this subject, by John Trowbridge, of the Physical Laboratory, Harvard University, U.S., appears in the August number of *Silliman's American Journal of Science*. The observatory of Harvard University (says Mr. Trowbridge) transmits time signals from Cambridge to Boston, a distance of about four miles. The regular recurrence of the beats of the clock affords a good means of studying the spreading of the electrical current from the terminal of the battery, which is grounded at the observatory; and the establishment of the Telephone Despatch companies in Cambridge, with their various ground connections, gave me a means of studying this spreading. In all the telephone circuits between Boston and Cambridge, in the neighbourhood of the direct line between these places, the ticking of the observatory clock could be heard. The ticking heard in the telephones at the various stations has been attributed to the proximity of the telephone circuit wires to the time wires from the observatory. This is evidently an erroneous conclusion, as will be evident from the following mathematical analysis given by Mr. Trowbridge.

The expression for the induction produced in one wire by making and breaking a current in a parallel wire is, according to Clerk Maxwell's "Electricity and Magnetism," Vol. II., p. 209:

$$R_2 y_2 = \pm M y_1,$$

where y_2 represents the induced current, R_2 the resistance of the circuit, M the co-efficient of induction between the parallel circuits, and y_1 the current in the primary circuit the interruption of which produced the induced currents in the secondary. Now,

$$M = \int\int \frac{ds\, ds'}{r},$$

where ds and ds' are elements of the parallel wires, and r is the perpendicular distance between them. The value of M in the case we are considering is

$$M = \frac{R_1^2}{r},$$

where R_1 represents the length of the parallel wires along which the induction takes place, and r is the distance between the wires.

We shall, therefore, have

$$R_2 y_2 = \pm \frac{R_1^2}{r} y_1. \quad . \quad . \quad . \quad . \quad . \quad (1).$$

Now, the electromotive force in the induced current y_2 is very much greater than that of the inducing current y_1, and in order that the current strength y_2 should be able to develop even a small electro-magnetic effect in the receiving telephone, the co-efficient of induction must be increased, or, in other words, the distance along which the conductors are parallel if the distance between them remains the same.

An arithmetical consideration of Eq. (1) will convince one that, with telephones of the resistance usually employed, no inductive effect will be perceived by the employment of even ten quart Bunsen cells between wires running parallel to each other a foot apart for a distance of 30 or 40 feet.

In order to detect an inductive effect under these conditions, a telephone of three or four units of resistance must be employed, whereas the ordinary Bell telephone has a resistance of from unity to forty units.

For still stronger reasons it is impossible to hear telephonic messages by induction from one wire to another, unless the two wires between which induction is produced run parallel to each and very near to each other a long distance. This distance generally exceeds the distance at which the ordinary Bell telephone ceases to transmit articulate speech. The effects which have usually been attributed to induction on telephone circuits are due to the earth connections and to imperfect insulation. There would be no trouble from induction if telephone wires were enclosed in cable; for a consideration of Eq. (1) will make it evident that the telephonic message transmitted over one wire would have no practical effect upon the neighbouring wires enclosed with it.

Having determined in this theoretical manner that the telephonic "echoes" as it were of the time signal service at Harvard Observatory, on the district telephone lines, were not due to induction, as is commonly believed, but to leakage of electricity from the clock circuit to the latter, Mr. Trowbridge proceeded to study the extent of the equally electrified or equi-potential surfaces of the ground surrounding the clock circuit at Harvard. He soon discovered that the time signals could be easily heard in a field an eighth of a mile from the observatory, where one "earth" of the time circuit is located. The method of exploration he employed was to run a wire five or six hundred feet long to earth at each end, and include a telephone of fifty or sixty ohms resistance in the circuit thus formed. On completing this exploratory circuit the evidence of an earth current was plainly apparent from the ticking sound which making and breaking the circuit caused in the telephone; and the time signals of the observatory clock could be distinctly heard. At a distance of a mile from the observatory, and not in the direct line between that place and the Boston Telephone Office, the time signals were obtained by tapping the earth, in the above manner, at two points only fifty feet apart. At a distance of five hundred feet, directly behind the observatory, no points five hundred feet apart could be found which were not practically at the same potential.

The survey was carried to a distance of a mile behind the observatory ground with negative results. At points one mile from the central line between the observatory and the Boston Office, the time signals could not be heard on the trial wire of six hundred feet. This was to be expected, since the trial wire should have its length increased as the distance from the grounds of the battery increases, in order to permit of one end of the wire touching a point of higher potential than the other.

"The theoretical possibility of telegraphing across the Atlantic without a cable is," says Mr. Trowbridge, "evident from the survey which I have undertaken. The practical possibility is another question."

At no point in his survey did he find an absence of what are called earth currents. The peculiar crackling noises heard in telephones are due to earth currents and not to fluctuations in the batteries employed on telephone circuits; for they were characteristic of the circuits employed by us in which the earth was used as a part of the circuit, and were absent when a battery circuit was closed without the intervention of the earth. The tick produced in the exploring telephone, whenever the circuit was closed through the ground, was due to earth currents, and not to polarisation between the copper wire and the moisture of the ground, for it was many hundred times stronger than the polarisation effect produced by dipping the copper terminals of the telephone wire in acidulated water. This crackling noise produced by the earth currents in a telephone is a curious phenomenon, and shows that the earth currents have a rapidly intermittent character, which escapes observation by any other instrument than the telephone. A delicate electro-dynamometer for the registration and observation of these intermittent earth currents is much to be desired. In some cases the pulsatory effect of these earth currents is very marked. At no point which we explored were evidences of earth currents absent. They seemed to be more pronounced along water courses.

In a discussion of the earth as a conductor (see "Die Anwendung des Electromagnetismus," p. 172, 2nd Ed. 1873) Steinheil says:—"We cannot conjure up gnomes at will to convey our thoughts through the earth. Nature has prevented this. The spreading of the galvanic effect is proportional, not to the distance of the point of excitation, but to the square of this distance; so that at the distance of fifty metres only exceedingly small effects can be produced by the most powerful electrical effects at the point of excitation. Had we means which could stand in the same relation to electricity that the eye stands to light, nothing would prevent our telegraphing through the earth without telegraphic conductors. But it is not probable that we shall ever attain this end."

The telephone of Professor Bell, though it is far from fulfilling the conditions required by Steinheil, is nevertheless our nearest approach to the desideratum, and after quoting these words of the famous German electrician, Mr. Trowbridge goes on to sketch a plan for telegraphing across the Atlantic. "Powerful dynamo-electric machines could be placid at some point in Nova Scotia, having one end of their circuit grounded near them, and the other end grounded in Florida, the conducting wire consisting of a wire of great conductivity, and carefully insulated from the earth, except at the two grounds (earths). By exploring the coast of France, two points on two surface lines not at the same potential could be found; and by means of a telephone of low resistance the Morse signals sent from Nova Scotia to Florida could be heard in France. Theoretically, this is possible; but, practically, with the light of our present knowledge, the expenditure of energy on the dynamo-electric engines would seem to be enormous."

Mr. Trowbridge seems to overlook the advantages of employing large condensers between the dynamo-electric machines and the earth. They would prove of great service in exalting the earth potentials at the terminal stations. Moreover, it is highly probable that some means of detecting the earth current still more sensitive than the *unaided* telephone will yet be discovered. But though it is quite likely that moderate distances may be telegraphed over without a wire, it is doubtful in the extreme whether the plan will ever become general or be applied to great distances, such, for instance, as the width of the Atlantic. One obvious practical objection to the method would

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be the difficulty of maintaining the privacy of messages. If the currents were spread abroad in the territorial manner indicated, they would, of course, be open to the world at large, and rival inland companies would be able to tap each other's messages, a condition of things which would lead to open warfare and hopeless confusion. Nevertheless, the matter is an interesting one, and far less promising ideas in the past have grown to practical importance.

The conclusions arrived at in Mr. Trowbridge's useful paper are given by himself as follows :—

1. Disturbances in telephonic circuits usually attributed to effects of induction are in general due to contiguous grounds of battery circuits. A return wire is the only way to obviate these disturbances.

2. The well-defined equipotential surfaces in the neighbourhood of a battery earth show the theoretical possibility of telegraphing across large bodies of water without the employment of a cable, and lead us to greatly extend the practical limit set by Steinheil.

3. Earth currents have an intermittent character, with periods or maxima and minima, which may occur several times a minute during the entire day. This intermittent character is seldom absent.

JOEL'S IMPROVEMENTS IN MAGNETO-ELECTRIC MACHINES AND ELECTRIC LIGHT APPARATUS.

(*Specification dated 16th December*, 1879. *No.* 5157.)

The specification states that this invention relates to certain peculiar constructions and arrangements of dynamo-magneto electric or electro-magnetic machines or apparatus for producing currents of electricity, the same being suitable for the purpose of light, heat, or motive power; also to certain peculiar constructions and arrangements of electric light lamps or apparatus. The improvements in magneto-electric machines or apparatus for producing electric currents consist essentially of a new, simple, and convenient combination of inducing electro-magnets or permanent magnets with induced electro-magnetic armatures or coils, whereby great surface is brought into magnetic action, and a special and additional induction current is produced by the reaction of the aforesaid armature coils upon the wire of the inducing electro-magnets or upon separate coils, the armature coils thus becoming in their turn inducing magnets. Also, of special arrangements of inducing and induced magnets and coils, whereby constant currents are produced without the aid of a commutator, and whereby distinct and separate circuits and currents are formed for exciting the inducing electro-magnets, and for feeding a light or motive power engine at one and the same time from one machine. Also, of a peculiar construction and arrangement of inducing electro-magnets, and also of a peculiar arrangement whereby the retention of magnetism in the induced cores is made to automatically regulate, by means of a commutator, the change of direction of the currents.

The automatic commutator is described by the inventor as follows :—"I arrange soft iron prolongations to the ends of the surrounding and induced electro-magnets, so as to project down and in front of a rim of soft iron attached to the commutator, the commutator itself being made free to move on the axle, and attached thereto by a strong spiral spring. Whilst the induced electro-magnet coils are magnetised, the movement of the commutator is retarded, but when the currents are changing and there is no magnetism in those coils, the spiral spring exerts itself forward and assists the changing of the commutator. The mode of fixing the commutator as above described is useful in any magneto machine, not only by reason of the magnetic action described above, but also by the centrifugal action which may be made to retard the commutator so as to correspond with the retention of magnetism in the cores; I refer more especially to its use in the Paccinotti machine." In regard to the improved electric-light apparatus, the inventor states that "It consists essentially of an arrangement for making good electrical contact on electrodes, whilst the movement of the electrode is rendered more certain, and the lateral and forward pressures thereon have a definable and adjustible ratio the one to the other. I further arrange a short circuiting contact in combination with the above. Also of an arrangement of contacts and supports for electric lights, whether on the incandescent or arc system. Also of improvements in the details of such lamps. Also of an improved system and arrangement for regulating the length and steadiness of a voltaic arc light, and keeping it constant. Also of a new electrode, whereby the arc light may be formed by the electrodes being kept touching each other; also of the special use of carbon as a convenient resistance for electric light circuits."

The various details of the invention are particularly described with reference to the drawings annexed to the specification.

TRIPLICATE MARSEILLES AND ALGIERS CABLE.

The ss. "Dacia," Capt. Hayward, belonging to the India Rubber, Gutta Percha, and Telegraph Works Company, left Greenhithe on Sunday, the 13th instant, for the Mediterranean to lay a third cable for the French Government between Marseilles and Algiers. The expedition is under the charge of Mr. R. K. Gray, engineer to the India Rubber Company. We have already given particulars of the cable as regards length and type (see *Electrician*, July 31). The insulation resistance is about 700 megohms at 75° Fahrenheit. The ship carries two electric lights, the current being supplied by two Gramme machines worked by two separate engines. These lights light the deck for paying out, picking up and sounding. The lamps have an ingenious hand adjustment. Regnier lamps are carried for lighting the tanks. A sounding wire apparatus, with improved self-adjusting break, is fixed permanently at the taffrail, on the starboard side, the cable stern sheave being on the port side. The machine is driven by a small engine fixed close to it, and connected by driving wheels with vulcanised india rubber tires. The ship carries a buoy containing tanks filled with gas and carrying a well-designed lamp. Electric signals are fitted from bow, stern, and bridge to the engine room and helm. These have been in use in the ship for several years, and answer very well indeed. A system of electric bells between all the cabins, chart rooms, deck-houses and saloon, to the stewards' pantry, is fitted; and altogether the arrangements show that all appliances are being tried that will facilitate the work and thus reduce its cost. Mr. R. K. Gray is, as we have stated, engineer in charge; Mr. E. M. Webb is chief electrician; and there is an excellent staff of assistants, including Mr. Page, who has charge of the electric lighting apparatus, Mr. J. Gray, Mr. C. Gray, Mr. Jones, and Mr. Bosse. Several gentlemen more or less connected with the company or with telegraphy have, through the courtesy of the directors, received passages as vistors, including Mr. Tyler (the secretary to the company), Mr. Foster (son of the late Mr. Le Neve Foster, formerly the much repected secretary to the Society of Arts), Mr. Robinson (secretary to the West Coast of America Telegraph Company), Mr. Alfred Niaudet (the well-known French electrician), Mr. Jackson, and Mr. H. L. Webb. It is expected that the work will be completed and the "Dacia" back at Silvertown in about six weeks, and she will soon afterwards start with the "International," to lay the new Mexican cable. The steamer "Newfield" will start in about a fortnight from Silvertown to lay the several cables for the Canadian Government which are being made at Silvertown. Mr. King, formerly engineer to the Western and Brazilian Telegraph Company, has charge of this work.

THE ELECTRIC DISCHARGE IN RAREFIED GASES.

Several continental *savants* are engaged just now in controverting the claim of Mr. Crookes to the discovery of a fourth state of matter, and otherwise prosecuting the same line of research. The well-known electrician, Dr. Gintl, of Prague, one of the original inventors of the duplex system of transmission, has arrived at the conclusion that the light seen at the negative poles in Crookes's rarefied tubes is due to molecules of the metallic electrode torn off by the discharge, an opinion which is sustained by Dr. Pulutz, of Vienna. Articles interposed in the molecular stream have been found to acquire a coating of the atoms, and if this coating does not take place in the case of an aluminium pole (as has been pointed out by a supporter of Mr. Crookes), it may be due to the fact, elicited by some experiments of Herr E. Wiedemann, that aluminium poles are least liable to dissegregation under the the electric discharge. Dr. Pulutz, we learn from our contemporary *l'Electricité*, has contrived a pretty electric light from the negative discharge in a vacuum tube from a Ruhmkorff coil capable of giving a spark of ten centimetres in length. In this device the metallic dust wrenched from the metal pole is concentrated upon a positive pole of carbon which reaches a red heat but suffers no loss of matter.

The latest published researches on this interesting subject are those of M. Righi, recently communicated to the French Academy of Sciences. His results are as follows :—

1. If, while we produce by means of a Ruhmkorff coil the

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illumination of a Crookes vacuum tube (for example, one of those in which the negative electrode is cylindrical or spherical), we approach to the glass a conductor connected to the negative electrode, and if at the same time, by means of a magnet, we cause the discharge to bend itself towards the same side of the tube, we shall observe a dark spot produce itself in the midst of the green fluorescence at the part where the glass is negatively charged. It would appear, therefore, that the glass becomes luminous at the point where it acts like a positive electrode.

This results equally from the two following experiments :—

2. Let us insulate one of these tubes by means of long silk threads and approach to the wall a ball communicating with the positive conductor of a Holtz machine. The electrodes of the tube emit positive electricity into the air, and negative is emitted by a point applied to the conductor. The green fluorescence appears upon the electrified wall of the tube, which acts as the positive electrode in the interior discharge.

3. M. Righi has approached the same ball, or a metallic point to the wall, or a little cylindrical Geissler tube containing sulphate of calcium, or phosphorescent strontium. The powder becomes strongly luminous, opposite the ball, if it is negative, and very feebly luminous if it is positive. If the ball, being negative, is placed near the extremity of the tube in such a way that one of the electrodes is between the ball and powder, we distinctly observe the shadow of the electrode project itself upon the powder. We thus obtain with an ordinary Geissler tube one of the striking phenomena described by Mr. Crookes.

4. The pale light, azure or violet, that is seen to fill the tubes of Crookes is strongly influenced by the hand or by conductors brought near the tube. M. Righi has connected the electrodes of the tube with the conductors of the Holtz machine (without condensers), and has approached insulated balls connected with the two electrodes. Under these circumstances he always finds that the light due to the discharge is attracted by the positive ball, and repelled by the negative one, that is to say, the discharge acts like a body negatively electrified. He has observed this phenomenon, although with less evidence, in Geissler tubes and particularly in the little tubes containing nitrogen or carbonic acid. Ordinarily the hand repels the discharge, perhaps because it charges itself under the influence of the tube. See the next experiment.

5. Mr. Crookes has shown that all insulated conductors introduced into one of the tubes charge themselves positively. The following experiment of M. Righi explains this phenomenon.

If, while the current from a Holtz machine is made to pass in a long Crookes tube, we approach to it perpendicularly by one of its electrodes, a small Geissler tube, the other electrode of which is held in the hand, we see in the latter tube a discharge directed from the long tube in the hand. If the potential of the positive conductor is reduced to zero, the little tube becomes dark; but if, on the contrary, we touch the negative conductor, the little tube is traversed by the discharge. It seems, then, that the long tube almost throughout has a potential little different from that of the positive electrode, and that near the negative electrode there occurs a very great fall of potential. It is, therefore, probable that during the discharge the negative electrode becomes, heated much more than the positive electrode.

6. This is demonstrated by M. Righi by the following experiment:—The discharge from an induction coil is sent through the electric radiometer; holding the latter in such a position that the mill cannot turn. The discharge is then interrupted, and the apparatus brought back to its normal position, taking care to avoid turning the mill by shocks in the ordinary way or even giving it a negative rotation. Very soon the mill will begin to turn almost with the same swiftness and in the same direction as if the apparatus was still traversed by the discharge. The cause which makes the mill turn is apparently the heat developed when the rains act as negative electrodes.

According to this experiment, the cause of the mechanical actions proper to the negative electrode are the same as in the radiometer. The electric force of the negative electrode upon the molecules which rush from it charged with negative electricity ought to tend to direct them normally to the surface of the same electrode. When these molecules collide with the glass they discharge themselves upon it, and the glass becomes luminous (see experiment No. 1). In fact, it is often noticeable that discharges pass from the positive electrode to the fluorescent portions of the glass.

THE FIRE-DAMP PHOTOMETER.—An illustrated description of this apparatus, the invention of Mr. E. H. Liveing, in which two platinum helices are rendered incandescent by the passage of a current, a difference of luminosity being produced by the presence of fire-damp, appears in the current number of *La Révue Industrielle*.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROFESSOR A. G. BELL ON SELENIUM AND THE PHOTOPHONE, &c.

In bringing before you some discoveries made by Mr. Sumner Tainter and myself, which have resulted in the construction of apparatus for the production and reproduction of sound by means of light, it is necessary to explain the state of knowledge which formed the starting point of our experiments. I shall first describe the remarkable substance selenium, and the manipulations devised by various experiments; but the final result of our researches has evidenced the class of substances sensitive to light-vibrations, until we can propound the fact of such sensitiveness being a general property of all matter. We have found this property in gold, silver, platinum, iron, steel, brass, copper, zinc, lead, antimony, German silver, Jenkin's metal, Babbitt's metal, ivory, celluloid, gutta percha, hard rubber, soft vulcanised rubber, paper, parchment, wood, mica, and silvered glass; and the only substances from which we have not obtained results are carbon and thin microscopic glass. We find that when a vibratory beam of light falls upon these substances they emit sounds, the pitch of which depends upon the frequency of the vibratory change in the light. We find farther that, when we control the form or character of the light-vibration on selenium, and probably on the other substances, we control the quality of the sound and obtain all varieties of articulate speech. We can thus, without a conducting wire as in electric telephony, speak from station to station, wherever we can project a beam of light. We have not had opportunity of testing the limit to which this photophonic influence can be extended, but we have spoken to and from points 213 metres apart; and there seems no reason to doubt that the results will be obtained at whatever distance a beam of light can be flashed from one observatory to another. The necessary privacy of our experiments hitherto has alone prevented any attempts at determining the extreme distance at which this new method of vocal communication will be available. I shall now speak of selenium.

SELENIUM.

In the year 1817 Berzelius and Gottlieb Gahn made an examination of the method of preparing sulphuric acid in use at Gripsholm. During the course of this examination they observed in the acid a sediment of a partly reddish, partly clear brown colour, which, under the action of the blow-pipe, gave out a peculiar odour, like that attributed by Klaproth to tellurium. As tellurium was a substance of extreme rarity, Berzelius attempted its production from this deposit; but he was unable, after many experiments, to obtain further indications of its presence. He found plentiful signs of sulphur mixed with mercury, copper, zinc, iron, arsenic, and lead, but no trace of tellurium. It was not in the nature of Berzelius to be disheartened by this result. In science every failure advances the boundary of knowledge as well as every success, and Berzelius felt that, if the characteristic odour that had been observed did not proceed from tellurium, it might possibly indicate the presence of some substance then unknown to the chemist. Urged on by this hope he returned with renewed ardour to his work. He collected a great quantity of the material, and submitted the whole mass to various chemical processes. He succeeded in separating successively the sulphur, the mercury, the copper, the tin, and the other known substances whose presence had been indicated by his tests; and, after all these had been eliminated, there still remained a residue which proved upon examination to be what he had been in search of—a new elementary substance. The chemical properties of this new element were found to resemble those of tellurium in so remarkable a degree that Berzelius gave to the substance the name of "Selenium," from the Greek word *selene*, the moon ("tellurium," as is well known, being derived from *tellus*, the earth).

Although tellurium and selenium are alike in many respects, they differ in their electrical properties; tellurium being a good conductor of electricity, and selenium, as Berzelius showed, a non-conductor. Knox discovered, in 1837, that selenium became a conductor when fused; and Hittorff, in 1852, showed that it conducted, at ordinary temperatures, when in one of its allotropic forms. When selenium is rapidly cooled from a fused condition it is a non-conductor. In this, its vitreous form, it is of a dark-brown colour, almost black by reflected light, having an exceedingly brilliant surface. In thin films it is transparent, and appears of a beautiful ruby red by transmitted light. When selenium is cooled from a fused condition with extreme slowness it presents an entirely different appearance, being of a dull lead colour, and having throughout a granulated or crystalline struc-

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ture, and looking like a metal. In this form it is perfectly opaque to light, even in very thin films. This variety of selenium has long been known as "granular" or "crystalline" selenium, or, as Regnault called it, "metallic" selenium. It was selenium of this kind that Hittorff found to be a conductor of electricity at ordinary temperatures. He also found that its resistance to the passage of an electrical current diminished continuously by heating up to the point of fusion, and that the resistance suddenly increased in passing from the solid to the liquid condition. It was early discovered that exposure to sunlight hastens the change of selenium from one allotropic form to another; and this observation is significant in the light of recent discoveries.

EXPERIMENTS WITH SELENIUM.

Although selenium has been known for the last sixty years, it has not yet been utilised to any extent in the arts, and it is still considered simply as a chemical curiosity. It is usually supplied in the form of cylindrical bars. These bars are sometimes found to be in the metallic condition; but more usually they are in the vitreous or non-conducting form. It occurred to Willoughby Smith that, on account of the high resistance of crystalline selenium, it might be usefully employed at the shore-end of a submarine cable in his system of testing and signalling during the process of submersion. Upon experiment, the selenium was found to have all the resistance required—some of the bars employed measuring as much as 1,400 megohms—a resistance equivalent to that which would be offered by a telegraph wire long enough to reach from the earth to the sun! But the resistance was found to be extremely variable. Experiments were made to ascertain the cause of this variability. Mr. May, Mr. Willoughby Smith's assistant, discovered that the resistance was less when the selenium was exposed to light than when it was in the dark.

In order to be certain that temperature had nothing to do with the effect, the selenium was placed in a vessel of water, so that the light had to pass through from one to two inches of water in order to reach the selenium. The approach of a lighted candle was found to be sufficient to cause a marked deflection of the needle of the galvanometer connected with the selenium, and the lighting of a piece of magnesium wire caused the selenium to measure less than half the resistance it did the moment before.

These results were naturally at first received by scientific men with some incredulity, but they were verified by Sale, Draper, Moss, and others. When selenium is exposed to the action of the solar spectrum, the maximum effect is produced, according to Sale, just outside the red end of the spectrum, in a point nearly co-incident with the maximum of the heat-rays; but, according to Adams, the maximum effect is produced in the greenish yellow or most luminous part of the spectrum. Lord Rosse exposed selenium to the action of non-luminous radiations from hot bodies, but could produce no effect; whereas a thermopile under similar circumstances gave abundant indications of a current. He also cut off the heat-rays from luminous bodies by the interposition of liquid solutions, such as alum, between the selenium and the source of light, without affecting the power of the light to reduce the resistance of the selenium; whereas the interposition of these same substances almost completely neutralised the effect upon the thermopile. Adams found that selenium was sensitive to the cold light of the moon, and Werner Siemens discovered that in certain extremely sensitive varieties of selenium heat and light produced opposite effects. In Siemens's experiments special arrangements were made for the purpose of reducing the resistance of the selenium employed. Two fine platinum wires were coiled together in the shape of a double flat spiral in the zig-zag shape, and were laid upon a plate of mica so that the discs did not touch one another. A drop of melted selenium was then placed upon the platinum-wire arrangement, and a second sheet of mica was pressed upon the selenium, so as to cause it to spread out and fill the spaces between the wires. Each cell was about the size of a silver dime. The selenium cells were then placed in a paraffin bath, and exposed for some hours to a temperature of 210° C, after which they were allowed to cool with extreme slowness. The results obtained with these cells were very extraordinary; in some cases the resistance of the cells when exposed to light was only one-fifteenth of their resistance in the dark.

Without dwelling farther upon the researches of others, I may say that the chief information concerning the effect of light upon the conductivity of selenium will be found under the names of Willoughby Smith, Lieutenant Sale, Draper and Moss, Professor W. G. Adams, Lord Rosse, Day, Sabini, Dr. Werner Siemens and Dr. C. W. Siemens. All observations by these various authors had been made by means of galvanometers; but it occurred to me that the telephone, from its extreme sensitiveness to electrical influences, might be substituted with advantage. Upon consideration of the subject, however, I saw that the experiments could not be conducted in the ordinary way for the following reason: The law of audibility of the telephone is precisely analogous to the law of electric induction. No effect is produced during the passage of a continuous and steady current. It is only at the moment of change from a stronger to a weaker state, or *vice versâ*, that any audible effect is produced, and the amount of effect is exactly proportional to the amount of variation in the current. It was, therefore, evident that the telephone could only respond to the effect produced in selenium at the moment of change from light to darkness, or *vice versâ*; and that it would be advisable to intermit the light with great rapidity, so as to produce a succession of changes in the conductivity of the selenium, corresponding in frequency to musical vibrations within the limits of the sense of hearing. For I had often noticed that currents of electricity, so feeble as to produce scarcely any audible effects from a telephone when the circuit was simply opened or closed, caused very perceptible musical sounds when the circuit was rapidly interrupted, and that the higher the pitch of sound the more audible was the effect. I was much struck by the idea of producing sound by the action of light in this way. Upon further consideration it appeared to me that all the audible effects obtained from varieties of electricity could also be produced by variations of light acting upon selenium. I saw that the effect could be produced at the extreme distance at which selenium would respond to the action of a luminous body, but that this distance could be indefinitely increased by the use of a parallel beam of light, so that we could telephone from one place to another without the necessity of a conducting wire between the transmitter and receiver. It was evidently necessary, in order to reduce this idea to practice, to devise an apparatus to be operated by the voice of a speaker, by which variations could be produced in a parallel beam of light, corresponding to the variations in the air produced by the voice.

(TO BE CONTINUED).

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 15.		Business Done Week Ending Sept. 15. Highest.	Lowest.
Anglo-American Ordinary	65⅛,	⅝	65⅝	65⅛
Do. "B"	97,	½	97¼	96
Do. "A"	36⅛,	37	37	36½
Brazilian	9⅛,	¼	9¼	9 3-16
Cuba	9⅛,	⅜	9 11-16	9 11-16
Do. Ten per Cent. Pref.	16¼,	¾	16¾	16¾
Direct Spanish	1⅞,	2⅛	—	—
Do. Ten per Cent. Preference	11⅝,	12⅛	11⅞	11⅞
Direct United States	12⅜,	⅝	12⅝	12⅝
Eastern	9 13-16,	15-16	9⅞	9 11-16
Do. Six per Cent. Debenture	106,	108	107	107
Do. Five per Ct. do. 1899	103,	106	103	103
Do. Six p Ct. Pref.	12⅝,	⅞	12¾	12¾
Eastern Extension	10,	⅛	10	9¾
Do. Six per Ct. Deb	106,	109	108¼	108¼
German Union	9⅛,	⅝	9½	9½
Globe Telegraph & Trust	6 13-16,	15-16	6 15-16	6⅝
Do. Six p Ct. Preference	12⅛,	⅝	12⅜	12⅜
Great Northern	10,	¼	10⅛	10
Indo-European	24⅞,	25¼	25¼	25⅛
Mediterranean Extension	2⅞,	3⅛	3⅜	3⅜
Do. Eight per Cent. Preference	10⅞,	11¼	—	—
Reuter's	9⅜,	10⅛	—	—
Submarine	240,	245	—	—
West India and Panama	1 7-16,	9-16	1⅝	1½
Do. Six per Cent. 1st Preference	7⅞,	⅝	7⅞	7⅞
Western and Brazilian	7⅝	¾	7⅝	7 9-16
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	102,	104	—	—

TRAFFIC RECEIPTS FOR AUGUST, 1880.

Companies.	Aug., 1880.	Aug., 1879.	Increase.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,000 estd.	2,557	—	557
Direct Spanish Telegraph Company	1,197	996	201	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,988	36,257	6,731	—
Eastern Extension Telegraph Company	30,249	26,242	4,007	—
Great Northern Telegraph Company	22,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Stationed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,321	220	A. Hyde	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	Ordered home.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Silvertown.
Telegraph Construction	ss Edinburgh	2,330	275	Seymour	Greenwich.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	E. Coast of Africa.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	Killett	Atlantic.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miguelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Syra.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	Cato	London.
Telegraph Construction	ss Seine	3,579	500	Manning	London.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	——	Dover.
H.M. Indian Government	Patrick Steward	1,130	130	A. W. Stiffe	Persian Gulf.

* This vessel sails under the French flag.

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SLIP

CANDAHAR.—The India Office reports that the telegraph is now established through to Candahar.

BRITISH COLUMBIA.—The cable between Henry and Sydney Islands is not at work, owing to a fault which is not yet repaired.

NEW SOUTH WALES.—The cost of the Public Buildings at Bathurst, which include post and telegraph offices, was about £38,000.

WRECK OF THE SORATO.—This vessel had on board the exhibit of Messrs. Walker and Hall, silver platers of Sheffield, intended for the Melbourne exhibition.

THE GOWER TELEPHONE.—An article on Telephonic communication in Paris, by means of this system of construction, appears in *La Nature*, from the pen of M. Hospitalier.

THE SS. "DACIA."—This vessel, freighted with the cable to form a third line of communication between Marseilles and Algiers, arrived at the latter station on the 21st inst.

SWANSEA.—The British Association formally opened the telephone line between the Guildhall, Swansea, and the waterworks (8½ miles). Whilst they were in Swansea, the president congratulated the contractor on its success, and spoke very highly of the instruments used (Gower-Bell). It is expected that a Gower-Bell Telephone Exchange will be shortly established at Swansea.

CRETE.—It will be remembered that we had last year to record the atrocious murder in Cyprus of Mr. Anderson, nephew of Sir James Anderson. The following telegram has just been received referring to the condemnation of the accused murderer:—"Following from Consul Sandwith, Canea (Crete). The man accused of murder of Anderson has been condemned to 15 years imprisonment."

THE ATLANTIC CABLE COMPETITION.—According to the *Côte Européenne*, the Compagnie Française du Télégraphe de Paris á New York, which at present works the cable known as the Pouyer Quertier cable, has definitively accepted the terms offered by the English companies for terminating the existing competition in Atlantic telegraphy. The agreement is made subject to its ratification by the French and American Governments.

ELECTRICAL ILLUMINATION OF MOUNT VESUVIUS.—The *Electrotechnische Zeitschrift* reports that the first experiments with the electric light on the Vesuvian railway took place recently under the direction of M. C. Moleschott and of the engineer Girolamo Taddei, who represents in Italy the firm of Siemens and Halske. Only fourteen differential lamps were used, being maintained in action by a dynamo machine of medium size giving alternating currents.

ELECTRICAL ILLUMINATION FROM ELEVATED POINTS.—There was very little to encourage the project to illuminate Holyoke, Mass., by means of lofty electric light towers, in the result of the similar experiment tried in Rouen, France, during the *fêtes* of July 13 and 14. On that occasion eight electric lights were placed on the spire of the cathedral, with a view of illuminating the town. Though the quantity of light was estimated at 5,000 Carcel burners, the effect was practically nil. The spire seemed merely to have a huge lamp on it, which threw its light beyond the town rather than in the neighbourhood of the cathedral. Perhaps this result may have been due to defective means for reflecting the light.

MUIRHEAD'S PATENT.—No doubt many readers of the daily papers were surprised to read that one of the last Bills to receive the Royal assent in the late session was one to make valid certain letters patent granted to Messrs. Muirhead for improvements in the working of electric telegraphs. It seems that the patentees having inadvertently omitted to pay the stamp duty of £50 at the end of the third year, nothing short of a special Act of Parliament could make good the omission. Messrs. Muirhead hold almost an unique position in obtaining such a special Act, but we doubt if their views are very favourable towards the present system of granting patents.

TOURISTS' TROUBLES.—Although the Eastern Company's station at Porthcurnow has been built over ten years, it is surprising how few of the visitors to the Logan Rock and the Land's End know of its existence until they see it on their way from the former to the latter place. Much amusement is caused by the passing comments. "What's this great place," says one? "A telegraph office," says another, "The guide called it the station." "Telegraph office your grandmother," says the first again, "what do they want of such a big place as this for a telegraph station?" in such a tone as if he felt hurt at being imposed on. A halt and consultation is then made, with the result that the name of some friend is thought of, and a telegram is to be sent to satisfy their curiosity, and so the Postal Telegraph Department is richer by one shilling, and the visitors are wiser than they were before.

THE LIGHTING OF PARIS.—The Municipal Authorities of Paris, in unison with the Gas and Electrical Lighting Companies, are, says *Galignani*, studying all sorts of plans for improving the illumination of the city. Large contracts are being signed for candelabras in cast iron and bronze for *lanterne-bouquets* (as the clusters of lamps on the street refuges are euphoniously called) and all their appurtenances; and very shortly, no doubt, Paris will be, if it is not already, the best lighted city in the world. The history of street illumination in the French metropolis presents a fair specimen of how that type of civilisation has progressed since the Middle Ages. Public street lamps or lanterns made their first appearance in Paris in the sixteenth century, though they were then but few in number and by no means perfect in themselves, street lighting being greatly improved by M. De la Reynie, an officer of the police, during the reign of Louis XIV. To judge from contemporary accounts the street lamps of the seventeenth and eighteenth centuries must have given a very picturesque appearance to the public promenades such as the Cours-la-Reine and quays along which they were placed. The invention of *réverbères*, or reflecting apparatus, dates from a hundred years or so back, and with its reflectors, oilpots, weights and counterweights the first *réverbère* must have been a rather complicated affair. Improvements were introduced by degrees, and reflectors were only dethroned at last, after a severe struggle, by gas.

A CURIOUS EXPERIMENT.—M. Schuster has called attention to the passage of which a translation is given below, and which occurs in an old book entitled "New Dissertation on the Electricity of Bodies," by M. Morin, professor at the Royal College of Chartres, correspondent of the Royal Academy of Sciences (Chartres, 1748; one vol. in 12mo). Unfortunately, the conditions for the repetition of the experiment—which, due allowance being made for some little exaggerations, is most probably susceptible of being repeated—are not very readily obtainable; otherwise considerable light might be thrown upon the undoubted phenomenon of "globular lightning." "Experiment XCIII. The 12th Jan., 1748, easterly

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wind and great cold. I stretched out a large cat on the coverlet of my bed, and on rubbing it I obtained in the darkness sparks of fire, the sound of which much resembled that of a comb when the hand is passed over the teeth. A thousand little points of fire danced about here and there, and, by continuing the friction, the sparks augmented to such an extent that they appeared like *spheres* or *balls* of fire, of the size of a hazel nut. I observed these little *globes* detach themselves from the body of the cat, fall upon the coverlet, rebound like foot-balls. . . . A thousand balls of fire were moving over the cat and on the coverlet; I observing attentively. I approached my eyes to a ball which appeared more luminous than the others. Immediately, I heard a kind of explosion or crackling, and felt a pricking sensation in the eyes. There was no shock in any other portion of the body; but the pain was followed by a weakness which caused me to fall on my side. It was some minutes before I recovered."

The Glasgow Exhibition.—The *Glasgow Herald* gives a little intelligence concerning the electric apparatus to be exhibited at Glasgow. It says:—"Electric lighting will be a prominent feature of the exhibition, applications for space having been made on behalf of several firms, whose dynamo-electric machines and lamps may not unlikely be submitted to a series of competitive tests of an exhaustive character by a committee of jurors, who may be regarded as experts in such matters. The leading exhibitor in this section will be Mr. R. E. Crompton, of London, whose scientific skill has already been well demonstrated by the lamp of his invention which is in operation at St. Enoch Station, certainly one of the best electric lamps yet brought into use. It is whispered, however, that before the exhibition closes there will be brought forward a lamp that is calculated to outstrip everything of the sort yet before the public. It is the invention of Mr. J. H. Gordon, the Assistant Secretary of the British Association, and is spoken of by leading authorities in matters electrical as a great scientific triumph. We may mention that it is proposed to put the electric light and gas light against each other in the Drill Hall. At the suggestion of Mr. J. L. Bruce, one of the members of the Executive Committee, and to whom in a great measure has been committed the subject of the hall arrangements, ventilation, &c., it is proposed to have the exhibition constantly under artificial light, one bay or span being given up to each of the two parties of exhibitors, those dealing in gas light and those who pin their reputation to the new light. It is intended also to have some of the 'great lights,' both gas and electric, shown in the grounds in front of the Drill Hall." We shall be agreeably astonished if anything startling in the way of lamps is exhibited, having long since come to the conclusion that perfection both of lamp and machine is necessarily gradual. However, our special correspondent will be able to give full information on this and other electrical questions.

The Ignition of Oil Tanks by Electrical Agency.—The *Scientific American* says:—"Again we have to record the destructive effects of lightning in the Bradford, Pa., oil regions. On the 28th of August, at 8:30 p.m., one of the 25,000-barrel oil tanks of the United Pipe Line Company, near State Line and Tarport, was set on fire by electricity and burned; also four smaller tanks on the West Branch near Bradford. At one time there was danger of a gigantic conflagration, as there were some twenty large tanks not far from the burning tank of the Pipe Company. By firing cannon shot into the tank its contents were run out and the adjacent property saved. From all we can gather there seems to be good ground for the theory that these numerous lightning disasters in the oil regions are not generally due to direct lightning strokes upon the tanks, but rather to the occurrence of slight electrical sparks within, upon, or near the tank, whereby the explosive gas that hovers about the tank is instantly set on fire. We have in our previous remarks suggested various ways in which the fatal spark may possibly be induced, to which suggestions the reader is referred. We have now to mention one other possible cause of the fires, and that is the electrified rain drops. Strong electrical effects are sometimes observed during the fall of sleet, hail, and rain, without the accompaniment of thunder or lightning. Professor Tait, in a recent lecture in Glasgow, said:—'Falling rain drops are often so strongly charged with electricity as to give a spark just before they touch the ground.' As the development of the slightest spark in connection with an explosive mixture of air and gas will produce intense fire, we here perceive the remarkable possibility that some of the great oil conflagrations may have been caused by rain. The whole subject is one of much interest to electricians, and, as we have before said, we hope they will investigate the matter, so as to ascertain surely the cause of these frequent disasters and discover the proper means of safety."

Telephones in Coal Mines.—A correspondent of *The Times* writes as under:—"*The Times* of the 9th of April last made mention of experiments which Lord Elphinstone had invited interested persons to witness in communicating by means of the telephone from the bottom of the Carberry coal pit with those upon the surface. The success of the experimental trial so clearly demonstrated the facility with which telephonic communication might be established and rendered of practical utility in the every-day working of the mines, that Messrs. Deans and Moor, the lessees, have since had strongly protected wires run from their office at the surface and apparatus fixed at different portions of the underground workings, one at the extreme lowest point, by means of which verbal communication may be carried on and the condition of the working of the pumping machinery may at any time be ascertained by the engineer above by merely listening to the sounds given out by the valves and other moving portions of the pumps, transmitted by the telephone to the surface from parts of the works most difficult of access. Had the Seaham pit been similarly supplied with the means of telephonic communication, what hours of anxiety as to the fate of those engaged in the several lower seams would have been spared, and how invaluable to the exploring parties, as they advanced step by step deeper amid the scenes of death and devastation, would the means of instantaneous communication with the surface have proved. It is only when such accidents occur that opportunities offer for bringing such facts home to the minds of persons generally. I have been informed that in one, at least, of our Australian colonies the establishment of means of instantaneous communication with those employed in mines has in some cases been compulsorily enforced by the Legislature. Seeing how comparatively insignificant is the cost, would it be any hardship were coalowners in this country obliged to provide by the telegraph-telephone, or other effective signalling apparatus, a means of communicating from those below with those upon the surface? In some cases of accident, no doubt, the wires might be severed and communication cut off, but provided the work were properly done, it would be but seldom that interruption would occur."

Street Fire Alarms.—In reference to the discussion on these alarms and the abuses to which they have been sub-

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jected, a correspondent to a daily contemporary offers the following hints, imported from San Francisco: — "At the corner of every street a box is let in the wall containing the electric apparatus, having direct communication with each fire-brigade station and the Town Hall. At each of these places an alarum is rung inside and out, indicating the number corresponding with the box. Thus, supposing the number to be 243, the alarum sounds twice, then stops for about five seconds, then sounds four times, followed by the same interval, and then sounds three times. In each station there is a large board with the names of the streets and their numbers, so that a child could read at a glance the exact locality of the fire. To each box there are two keys, one held by the policeman on the beat and the other by the nearest tradesman. The law allows a heavy fine to be imposed upon any person tampering with the boxes or ringing a false alarm. At the first strike of the electric bell the horses are released from their stalls, and are sufficiently well trained to back themselves into their respective places. The firemen, who sleep over the stables, are out of bed before the second stroke of the bell, and in a few seconds are sliding from their loft into the yard. The driver simply has to hitch the horses on to the engine, another man opens the gates, a third lights up the boiler, and in less than 30 seconds from the first stroke of the bell, the engine, fully manned, is on its way to the fire. Owing to the prevailing winds in San Francisco, and the houses being built principally of wood, the city would have been reduced to ashes, like some of its sister cities, had it not been for the remarkable perfection of science, and the combined celerity and heroism of the Fire Brigade. It is deplorable that in the largest and richest city in the world houses should be half burnt out and human lives sacrificed before a drop of water can be poured upon the flames. That our firemen are brave no one can dispute; that the horses are fast many a pedestrian can testify by bodily disfigurement or mental shock; but it is like the man who missed the train and was chided for not running fast enough. 'Oh yes,' was the reply, as he sat down on his carpet bag and mopped his perspiring brow, 'I ran quite fast enough but didn't start soon enough.'" Some of the above statements will be familiar to those who heard the paper read by Mr. W. H. Preece on his return from America.

Gas v. Electricity.—It is a great pity that contemporary gas journals cannot accept the inevitable, and acknowledge that the electric light is such as to demand a fair trial. Yet it is evident a great soreness exists, whether from fear or not it is difficult to say. We have again and again pointed out that gas interests at present, and for, at any rate, some time to come, are not likely to suffer from the competition. There is no immediate prospect of the electric superseding the gas light, except in certain pretty well defined circumstances. The proceedings of the City Sewers Commissioners are closely, watched, as will be gleaned from the following extract from a contemporary devoted to the gas interest:— "Absolute secresy is being maintained respecting the proposals received by the Streets Committee of the City Sewers Commission in reply to their invitation for tenders for lighting the principal thoroughfares of the City by electricity. We shall, however, be probably not far from the truth in stating that the competition for the favours of the City authorities in the matter of street illumination was not so brisk among the various organisations for supplying electric lighting as might have been expected. If this should prove to be the case, and the scheme should consequently be curtailed or abandoned altogether, it will probably be owing principally to the grand scale on which the City authorities wished to have their experiment carried out. They, perhaps, being accustomed to see any demand on the Gas companies for more light easily met by the simple expedient of turning on more gas from sources to them unseen and apparently inexhaustible, may be pardoned for believing that the substitution of one method of lighting a few miles of streets for another was merely a question of arrangement of the details of apparatus, and that nothing would be easier than to 'welcome the coming, speed the parting guest.' And their belief in the power of any known form of electric lighting to take the place of gas at any moment, and to any required extent, may have been fostered by the blatant advocates of the party in opposition, who are never backward in attributing the slowness with which the electric light is spreading to anything but its own demerits, or the unreadiness of its purveyors. But it will not surprise those conversant with such matters if it should transpire that most of the respectable Electric Light companies find themselves unprepared to undertake more than a small, perchance a very small portion of the great work offered to them by the Sewers Commissioners. This eventuality would not at all deteriorate from the interest attaching to the experiment, provided that the competing parties are sufficiently numerous to make the exhibition important in the aggregate. There is one consolation which the Sewers Commissioners may lay to heart in case the Electric Light companies do not come up to time. The gas they have always with them, and if they want to get up a show of how streets can be lighted when the will to pay for brilliancy exists, they cannot do better than follow our previously-expressed counsel—to add to their earlier design the exhibition of the various improved methods of street illumination by gas, to some of which they are no strangers. If Electric Light companies are backward, gas burner and lamp manufacturers are eminently the opposite, and any or all of them who have already distinguished themselves in the conflict of gas with electricity would, we are assured, be only too pleased to take a mile or so of streets and show what they can do in turning night into day. Such a course as that above indicated would, as we have already said, make the proposed experiment really valuable and very instructive, whether the whole of the scheduled streets are finally given up to the electric light or not. There are many other thoroughfares, in continuation of, or in contiguity to the streets named, in which a brilliant light would be quite as useful, and we venture to hope that the competition which the Sewers Commission have attempted to inaugurate in a somewhat one-sided manner may be carried out at last on a fair and complete basis such as we have indicated." There is a painful lack of generosity in this quotation. The Commissioners are not acting differently now than at other times when tenders have to be discussed and approved concerning questions of an experimental nature. We believe the aim of the Commissioners is to distribute their favours, and give the principal systems a fair trial. There is no objection in letting gas compete in adjoining streets. The one or the other competitor will in the long run appear in front, and it is immaterial discussing what may happen. Gas has had the field for years, and such notes as these are evidence that no attempt has been made to give the public the best that could be obtained from the works, and we are bound to say it is fear that causes the agitation in the citadel. We want more light, and what is more, the moderate success of the electric light, tried as it has been in many unfavourable places, has determined the public to have more light.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROFESSOR A. G. BELL ON SELENIUM AND THE PHOTOPHONE, &c.

(CONCLUDED FROM PAGE 215.)

EXPERIMENT WITH LIGHT AS A PRODUCER OF SOUND.

I proposed to pass light through a large number of small orifices, which might be of any convenient shape, but were preferably in the form of slits. Two similarly perforated plates were to be employed. One was to be fixed and the other attached to the centre of a diaphragm actuated by the voice, so that the vibration of the diaphragm would cause the movable plate to slide to and fro over the surface of the fixed plate, thus alternately enlarging and contracting the free orifices for the passage of light. In this way the voice of a speaker could control the amount of light passed through the perforated plates without completely obstructing its passage. This apparatus was to be placed in the path of a parallel beam of light, and the undulatory beam emerging from the apparatus could be received at some distant place upon a lens, or other apparatus, by means of which it could be condensed upon a sensitive piece of selenium placed in a local circuit with a telephone and galvanic battery. The variations in the light produced by the voice of the speaker should cause corresponding variations in the electrical resistance of the selenium employed; and the telephone in circuit with it should reproduce audibly the tones and articulations of the speaker's voice. I obtained some selenium for the purpose of producing the apparatus shown; but found that its resistance was almost infinitely greater than that of any telephone that had been constructed, and I was unable to obtain any audible effects by the action of light. I believed, however, that the obstacle could be overcome by devising mechanical arrangements for reducing the resistance of the selenium, and by constructing special telephones for the purpose. I felt so much confidence in this that, in a lecture delivered before the Royal Institute of Great Britain, upon the 17th of May, 1878, I announced the possibility of hearing a shadow by interrupting the action of light upon selenium. A few days afterwards my ideas upon this subject received a fresh impetus by the announcement, made by Mr. Willoughby Smith before the Society of Telegraph Engineers, that he had heard the action of a ray of light falling upon a bar of crystalline selenium by listening to a telephone in circuit with it.

It is not unlikely that the publicity given to the speaking telephone during the last few years may have suggested to many minds in different parts of the world somewhat similar ideas to my own.

Although the idea of producing and reproducing sound by the action of light, as described above, was an entirely original and independent conception of my own, I recognise the fact that the knowledge necessary for its conception has been disseminated throughout the civilised world, and that the idea may therefore have occurred to many other minds. *The fundamental idea, on which rests the possibility of producing speech by the action of light, is the conception of what may be termed an undulatory beam of light in contradistinction to a merely intermittent one.* By an indulatory beam of light, I mean a beam that shines continuously upon the selenium receiver, but the intensity of which upon that receiver is subject to rapid changes, corresponding to the changes in the vibratory movement of a particle of air during the transmission of a sound of definite quality through the atmosphere. The curve that would graphically represent the changes of light would be similar in shape to that representing the movement of the air. I do not know whether this conception had been clearly realised by "J. F. W." of Kew, or by Mr. Sargent of Philadelphia; but to Mr. David Brown of London is undoubtedly due the honor of having distinctly and independently formulated the conception, and of having devised apparatus—though of a crude nature—for carrying it into execution. It is greatly due to the genius and perseverance of my friend Mr. Sumner Tainter of Watertown, Mass., that the problem of producing and reproducing sound by the agency of light has at last been successfully solved.

RESEARCHES BY MR. SUMNER TAINTER AND DR. A. GRAHAM BELL.

The first point to which we devoted our attention was the reduction of the resistance of crystalline selenium within manageable limits. The resistance of selenium cells employed by former experimenters was measured in millions of ohms, and we do not know of any record of a selenium cell measuring less than 250,000 ohms in the dark. *We have succeeded in producing sensitive selenium cells measuring only* 300 *ohms in the dark, and* 155 *ohms in the light.* All former experimenters seemed to have used platinum for the conducting part of their selenium cells, excepting Werner Siemens, who found that iron and copper might be employed. We have also discovered that brass, although chemically acted upon by selenium, forms an excellent and convenient material; indeed, we are inclined to believe that the chemical action between the brass and selenium has contributed to the low resistance of our cells by forming an intimate bond of union between the selenium and brass. We have observed that melted selenium behaves to the other substances as water to a greasy surface, and we are inclined to think that when selenium is used in connection with metals not chemically acted upon by it, the points of contact between selenium and the metal offer a considerable amount of resistance to the passage of a galvanic current. By using brass we have been enabled to construct a large number of selenium cells of different forms. The mode of applying the selenium is as follows: The cell is heated, and, when hot enough, a stick of selenium is rubbed over the surface. In order to acquire conductivity and sensitiveness, the selenium must next undergo a process of annealing.

We simply heat the selenium over a gas stove and observe its appearance. When the selenium attains a certain temperature the beautiful reflecting surface becomes dimmed. A cloudiness gradually extends over it, somewhat like the film of moisture produced by breathing upon a mirror. This appearance gradually increases, and the whole surface is soon seen to be in the metallic, granular or crystalline condition. The cell may then be taken off the stove, and cooled in any suitable way. When the heating process is carried too far, the crystalline selenium is seen to melt. Our best results have been obtained by heating the selenium until it crystallises, and continuing the heating until signs of melting appear, when the gas is immediately put out. The portions that had melted instantly recrystallise, and the selenium is found upon cooling to be a conductor, and to be sensitive to light. The whole operation occupies only a few minutes. This method has not only the advantage of being expeditious, but it proves that many of the accepted theories on this subject are fallacious. Our new method shows that fusion is unnecessary, that conductivity and sensitiveness can be produced without long heating and slow cooling, and that crystallisation takes place during the heating process. We have found that on removing the source of heat immediately on the appearance of the cloudiness, distinct and separate crystals can be observed under the microscope, which appear like leaden snow flakes on a ground of ruby red. Upon removing the heat, when crystallisation is further advanced, we perceive under the microscope masses of these crystals arranged like basaltic columns standing detached from one another, and at a still higher point of heating the distinct columns are no longer traceable, but the whole mass resembles metallic pudding stone, with here and there a separate snow flake, like a fossil, on the surface. Selenium crystals formed during slow cooling after fusion present an entirely different appearance, showing distinct facets.

PHOTOPHONIC TRANSMITTERS.

We have devised about fifty forms of apparatus for varying a beam of light in the manner required, but only a few typical varieties need be shown. The source of light may be controlled, or a steady beam may be modified at any point in its path. The beam may be controlled in many ways. For instance, it may be polarised, and then affected by electrical or magnetic influences in the manner discovered by Faraday and Dr. Ker. The beam of polarised light, instead of being passed through a liquid, may be reflected from the polished pole of an electro-magnet. Another method of affecting a beam of light is to pass it through a lens of variable focus. I observe that a lens of this kind has been invented in France by Dr. Cusco, and is fully described in a recent paper in *La Nature*; but Mr. Tainter and I have used such a lens in our experiments for months past. The best and simplest form of apparatus for producing the effect remains to be described. This consists of a plane mirror of flexible material —such as silvered mica or microscope glass. Against the back of this mirror the speaker's voice is directed. The light reflected from this mirror is thus thrown into vibrations corresponding to those of the diaphragm itself.

ARRANGEMENT OF APPARATUS FOR THE REPRODUCTION OF SOUND BY LIGHT.

In arranging the apparatus for the purpose of reproducing sound at a distance, any powerful source of light may be used, but we have experimented chiefly with sunlight. For this purpose a large beam is concentrated by means of a lens upon the diaphragm-mirror, and, after reflection, is again rendered parallel by means of another lens. The beam is received at a distant station upon a parabolic reflector, in the focus of which is placed a sensitive selenium cell, connected in a local circuit with a battery and telephone. A large number of trials of this apparatus have been made with the transmitting and receiving

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instruments so far apart that sounds could not be heard directly through the air. In illustration, I shall describe one of the most recent of these experiments. Mr. Tainter operated the transmitting instrument, which was placed on the top of the Franklin schoolhouse in Washington, and the sensitive receiver was arranged in one of the windows of my laboratory, 1325 L street, at a distance of 213 metres. Upon placing the telephone to my ear I heard distinctly from the illuminated receiver the words :—" Mr. Bell, if you hear what I say, come to the window and wave your hat." In laboratory experiments the transmitting and receiving instruments are necessarily within earshot of one another, and we have, therefore, been accustomed to pooling the electric circuit connected with the selenium receiver, so as to place the telephones in another room. By such experiments we have found that articulate speech can be reproduced by the oxy-hydrogen light, and even by the light of a kerosene lamp. The loudest effects obtained from light are produced by rapidly interrupting the beam by the perforated disc. The great advantage of this form of apparatus for experimental work is the noiselessness of its rotation, admitting the close approach of the receiver without interfering with the audibility of the effect heard from the latter; for it will be understood that musical tones are emitted from the receiver when no sound is made at the transmitter. A silent motion thus produces a sound. In this way musical tones have been heard even from the light of a candle. When distant effects are sought another apparatus is used. By placing an opaque screen near the rotating disc the beam can be entirely cut off by a slight motion of the hand, and musical signals, like the dots and dashes of the Morse telegraph code, can thus be produced at the distant receiving station.

We have made experiments, with the object of ascertaining the nature of the rays that affect selenium. For this purpose we have placed in the path of an intermittent beam various absorbing substances. Professor Cross has been kind enough to give me his assistance in conducting these experiments. When a solution of alum or bisulphide of carbon is employed, the loudness of the sound produced by the intermittent beam is very slightly diminished; but a solution of iodine in bisulphide of carbon cuts off most, but not all, of the audible effect. Even an apparently opaque sheet of hard rubber does not entirely do this. When the sheet of hard rubber was held near the disc interrupter, the rotation of the disc interrupted what was then an invisible beam, which passed over a space of about twelve feet before it reached the lens which finally concentrated it upon the selenium cell. A faint but perfectly perceptible musical tone was heard from the telephone connected with the selenium. This could be interrupted at will by placing the hand in the path of the invisible beam. It would be premature, without further experiments, to speculate too much concerning the nature of these invisible rays; but it is difficult to believe that they can be bent rays, as the effect is produced through two sheets of hard rubber, containing between them a saturated solution of alum. Although effects are produced as above shown by forms of radiant energy which are invisible, we have named the apparatus for the production and reproduction of sound in this way "*The Photophone*," because an ordinary beam of light contains the rays which are operative.

NON-ELECTRIC PHOTOPHONE RECEIVERS.

It is a well-known fact that the molecular disturbance produced in a mass of iron by the magnetising influence of an intermittent electrical current can be observed as sound by placing the ear in close contact with the iron. It occurred to us that the molecular disturbance produced in crystalline selenium by the action of an intermittent beam of light should be audible in a similar manner without the aid of a telephone or battery. Many experiments were made to verify this theory without definite results. The anomalous behaviour of the hard rubber screen suggested the thought of listening to it also. This experiment was tried with extraordinary success. I held the sheet in close contact with my ear, while a beam of intermittent light was focussed upon it by a lens. A distinct musical note was immediately heard. We found the effect intensified by arranging the sheet of hard rubber as a diaphragm, and listening through a hearing-tube. We then tried crystalline selenium in the form of a thin disc, and obtained a similar but less intense effect. The other substances which I enumerated at the beginning of my address were now successively tried in the form of thin discs, and sounds were obtained from all but carbon and thin glass. We found hard rubber to produce a louder sound than any other substance we tried, excepting antimony, and paper and mica to produce the weakest sounds. *On the whole, we feel warranted in announcing as our conclusion, that sounds can be produced by the action of a variable light from substances of all kinds, when in the form of thin diaphragms.* We have heard from interrupted sunlight very perceptible musical tunes through tubes of ordinary vulcanised rubber, of brass and of wood. These were all the materials at hand in tubular form, and we have had no opportunity since of extending the observations to other substances.

I am extremely glad that I have the opportunity of making the first publication of these researches before a scientific society, for it is from scientific men that my work of the last six years has received its earliest and kindest recognition. I gratefully remember the encouragement which I received from the late Professor Henry at a time when the speaking telephone existed only in theory. Indeed, it is greatly due to the stimulus of his appreciation that the telephone became an accomplished fact. I cannot state too highly also the advantage I received in preliminary experiments on sound vibrations in this building from Professor Cross, and near here from my valued friend Dr. Clarence J. Blake. When the public were incredulous of the possibility of electrical speech, the American Academy of Arts and Sciences, the Philosophical Society of Washington and the Essex Institute of Salem recognised the reality of the results and honoured me by their congratulations. The public interest, I think, was first awakened by the judgment of the very eminent scientific men before whom the telephone was exhibited in Philadelphia, and by the address of Sir William Thomson before the British Association for the Advancement of Science.

At a later period, when even practical telegraphers considered the telephone as a mere scientific toy, Professor John Peirce, Professor Eli W. Blake, Dr. Channing, Mr. Clarke and Mr. Jones of Providence, R. I., devoted themselves to a series of experiments for the purpose of assisting me in making the telephone of practical utility; and they communicated to me, from time to time, the result of their experiments with a kindness and generosity I can never forget. It is not only pleasant to remember these things and to speak of them, but it is a duty to repeat them, as they give a practical refutation to the often repeated stories of the blindness of scientific men to unaccredited novelties, and of their jealousy of unknown inventors who dare to enter the charmed circle of science. I trust that the scientific favour which was so readily accorded to the telephone may be extended by you to this new claimant—the photophone.

MILAN.—A trial of the electric light in combination with gas has been made at La Scala, Milan, with, it is said, excellent effect.

JERMYN-STREET.—We understand that the Museum of Practical Geology is in future to be illumined by electricity, and that arrangements are being made for its introduction immediately after the recess.

CABLE BETWEEN MALTA AND TRIPOLI.—The *Diritto* of the 21st inst. announced that the Italian Government has come to an arrangement with the Mediterranean Extension Telegraph Company to lay a cable between Malta and Tripoli, Italy granting the company a subsidy. We have reason to believe that this report, which has appeared in several of our contemporaries, is at least premature.

TELEGRAPHIC REFORM.—Mr. Fawcett will (the London correspondent of the *Manchester Guardian* says) give his consideration mainly during the recess to the whole question of telegraphic reform, including the vexed question of sixpenny telegrams in London, a more efficient service on Sundays, and the development of telephonic communication. Should he find time he will pay a visit in a few weeks to New York, where telegraphing, especially for the purposes of trade and commerce, is understood to be more perfect than anywhere else.

TELEGRAPHIC ERRORS.—A correspondent writes to a contemporary on this subject:—Having heard that some of their clients had received "first awards" at the Sydney Exhibition they telegraphed to know whether the awards were "gold," and having received a reply in the affirmative the information was communicated to the firms interested, and also made public. To the "vexatious disappointment" of those concerned it was discovered several months later that gold medals had not been bestowed, the mistake having arisen through the word "gold" being altered to "good" in transit. The writer is naturally annoyed, but it does not seem to us very remarkable that there should be a mistake of one letter occasionally in a message sent over so many thousands of miles of cable involving so many transmissions. Besides, should not the receivers of the message in question have suspected a mistake when they received a telegram asking if "first awards" were "good awards?" A little inquiry on their part at the telegraph office would probably have elicited that the word "good" might easily be substituted for "gold."

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THE ELECTRICIAN.

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OPEN COMPETITION FOR THE TELEGRAPH SERVICE.

When the Postmaster-General told the House of Commons that for the future female clerkships in the Post Office would be thrown open to public competition he began by saying that he was "glad to be able" to make the announcement. Usually, when a statement is prefaced in such terms as these it implies that in the speaker's estimation his audience will be as glad to hear what he has to say as he is to say it. It can hardly be supposed that Mr. Fawcett mistook the House for a woman's-rights' meeting, or that he even so far deceived himself as to imagine that his mode of rectifying one of women's wrongs would be received with unalloyed satisfaction by the country. His views on the female employment question are, indeed, too well known to render these suspicions altogether incredible; still, we think in the main that when he said he was glad, he meant he was glad to be rid of a personal inconvenience. The nomination to women clerkships in the Post Office is one of the few remaining vestiges of patronage surviving in the Civil Service; and it is perfectly intelligible that, to Mr. Fawcett, of all men in the world, the exercise of it has proved extremely irksome. Short of turning all the men kind into the streets, from the secretary's office down to the sorting department, nothing probably would adequately satisfy the present demands upon his consistency and philanthropy. This is one of the penalties which public teachers have to pay when they have the ill-luck to fall into a position which puts their professions to a practical test. Mr. Fawcett is exceptionally fortunate in being able to escape from an awkward situation not only with credit but even with *éclat*. He has secured the distinction of inaugurating open competition for a partially disqualified class; and, while relieving himself of their importunities, has secured the eternal gratitude of the aggrieved ones by placing them on a sort of equality with their oppressors.

As we are not addressing Mr. Fawcett's favoured clients we need not dwell upon the dubious character of the boon he is supposed to have conferred upon them. The general public regard it with what one of the newspapers calls "very mixed feelings." Just as everybody was becoming more or less convinced that open competition is not an entirely satisfactory substitute for selection by patronage, and that competitive examination of any kind is not a trustworthy test of fitness, Mr. Fawcett voluntarily consigns his right of choice to the blind machinery of the Civil Service commissioners. This we consider, on public grounds, is much to be regretted and were it not for the explanation we have suggested above it would be amazing. What we are chiefly concerned with is, of course, its effect upon the telegraph branch of the postal service, and as the number of situations open to females in the postal department are few, while those for the telegraph are many, and may be made more, we suspect that the latter will be most affected by the Postmaster-General's predilections. Moreover, what he has done for the females he cannot in consistency long withhold from the males; and the devotees of open competition have only to put on the inevitable screw to deprive the telegraph service of any discretion whatsoever in selecting candidates for its employment.

Now, we have no hesitation in saying that this is on the face of it a highly inconvenient outlook. There is not a telegraph company in existence that would consent to accept its servants on such terms; and we are tolerably safe in asserting that the heads of the Government telegraph offices would be equally emphatic in their refusal, if refusal were of any avail. For what does open competition mean? It means that all those niceties of character, of physique, habit, demeanour, and even of personal appearance, which would ordinarily determine the choice of a suitable candidate, must henceforth go for absolutely nothing. That qualities which an experienced telegraph superintendent would recognise as the right sort for his purpose should be backed up by educational acquirements, which an examination can alone ascertain, no one will deny; but that the examination is of itself a sufficient or even an approximate test cannot for a moment be believed. Education is undoubtedly valuable, and possibly the educational level of the telegraphist is not at present as high as it might be; but education is not everything, and, left to the trained judgment of an expert, the best scholar in the town would often be summarily set aside for a less learned, but brighter and more active, candidate. And this preference would be wisely exercised; for the artisan rather than the scholastic element is most needed in the working of the telegraph. We mean that the nimble fingers and quick eye, which are absolutely indispensable to the telegraph operator, are most commonly found amongst that class which are certainly not bookworms. The pale and sickly student, whether boy or girl, the precocious genius, whose parents think he is born to be a "clerk," or the overworked female pupil-teacher who hopes to find repose in a Government office, are not the stuff of which good telegraphists are made. At all events, this is not the material with which private telegraph companies, old or new, have built up their reputations; and unless the authorities are prepared to risk their reputation on the altar of political crotchets it is not the material for the existing telegraph administration.

We have on more than one occasion spoken at length upon the employment of females as telegraph operators, and we need only briefly recur to the subject again in this relation. We cannot here discuss the politico-economical aspect of the question. Whether women should be provided with wages instead of with husbands, whether the falling off of the marriage rate is wisely met by rendering marriage less urgent, or whether men may be left to shift for themselves so long as women are cared for, are questions which time and not argument will conclusively solve. But the employment of the weaker sex in the telegraph service is a problem capable of practical solution, and one which cannot be decided on sentimental grounds without injury to the public service. There is no objection to the female telegraphist as such; a telegram correctly transmitted or written by a girl is just as good as a correct telegram manipulated by a boy. But it must not be supposed that it is better simply because the motive in employing the girl happens to be better.

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As a matter of evidence the speed, the endurance, and the general excellence of the man surpass those of the woman in this as in most other branches of industry; and were the fact candidly recognised the quantity and kind of work assigned to women would be that alone which women can perform satisfactorily. In view of the rapid growth of telegraphic traffic, involving more continuous strain, probably later hours and heavier Sunday duty, the burden of which falls upon the male clerks, we have heard with surprise that the number of female clerks is again to be increased.

That the considerations adverted to in the foregoing remarks are not at present uppermost in the mind of the ruling power at the Post Office is apparent from the tone of other portions of Mr. Fawcett's speech. Women, he considerately assured his hearers, would not be required to travel long distances in order to undergo examination. This, no doubt, is quite as it should be; but the significant thing about it is the undisguised confession that woman must be allowed special privileges and exemptions. We are decidedly of opinion that she must; and it is precisely this conviction, together with a tolerably good notion of what the duties of a working telegraphist ought to be, that compel us to remember how many and anomalous must her exemptions and priviliges be if she pretend to undertake the duties at all. This is partly an economical question, and partly a question of fair play; but it is also of practical expediency. Men are able and ought to do all the hard work; but it is not in the economy of nature that nothing but the hard work shall be theirs. We doubt if even the proverbial navvy's constitution would hold out against all full barrows and no empty ones. The late Postmaster-General, a warm friend of female employment, publicly admitted that considerations of this sort had compelled him to moderate his enthusiasm somewhat in respect to the telegraph service. We hope that they will not be altogether lost sight of by his successor.

CORRESPONDENCE.

TELEPHONY AND TARGETS.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: It has occurred to me that the telephone might be used to obviate the possibility of a "Wimbledon scandal," and to avoid those accidents which happen, although rarely, to markers.

The thud or "clack," as it is called, of the bullet against the target is of a different pitch according to the distance it strikes from the centre. A telephone in circuit would enable a person to distinguish this distance with a little practice.* A committee could thus record the scores, or a phonograph could record the sound and reproduce it at any time. W. H. A.

HOW THEY TREAT TELEGRAPHISTS AT MOZAMBIQUE.

The following extract from a letter has been sent to us:—

Mozambique has been the scene of general rejoicing during the last eight or nine days in consequence of the appointment of a new and well appreciated acting Governor-General.

The cables brought the news from Lisbon in a few hours, news which one short year ago would have taken about thirty days to reach this place. Thus the new Governor-General has reason to acknowledge the facilities to be derived from telegraphic communication.

I am very glad to bear witness to the fact that H. E. is a staunch supporter of telegraphy, and therefore he never forgets its existence on the Island of Mozambique.

Dr. Augusto Cesar Rodrigues Sarmento has for several years been the Secretary General of the Province, and no one could be more suited than he is to fill the vice-regal chair. His experience has made him conversant with the working of all the commercial legal and social machinery of the Portuguese East African possessions; he is most highly esteemed by all departments; and last, but not least, he takes a remarkably and unusually lively interest in the suppression of slave-trading.

On the 11th instant, after having had the keys of Fort S. Sebastian given to him, and after having gone through various other duties in connection with the appointment, H. E. gave a dinner at which about forty heads of department sat down. I was invited as the superintendent of the telegraph station, but at the dinner I was treated as England's representative in the absence of Consul O'Neill.

The dinner was followed by music, and the band played "God save the Queen" twice.

Consul O'Neill received instructions to proceed to Blantyre to investigate the charges made by Mr. Chirnside against that mission, and he is now on his way there.

It is proposed that we give a ball at the club in honour of the Governor-General's appointment. H. E. is a Doctor of Laws.

Mozambique, Aug. 17, 1880. (Signed) W. H. D.

* This suggestion might be found practicable with iron targets, but not when paper targets are used.—ED. *E.*

COSMICAL INDUCTION.

The electric and magnetic influence of the sun, moon, and perhaps other planets, on the earth, is beginning to be a subject of study with astronomers and scientific electricians, and a recent paper by M. Quet to the French Academy of Sciences is an interesting contribution to the subject.

The sun, as M. Quet contends in this paper, induces the earth in various ways—by its rotation, by the velocity of the latter round its orbit, and by the rotation of the earth round its own axis, and also by the electrical changes which take place in the sun's own mass.

He holds, moreover, that the electromotive force due to the first cause is fourteen times greater than that due to the second cause, and that the latter is seventy-two times greater than that due to the third cause. M. Quet specially considers the induction due to the revolution of the earth, and investigates first to what point the earth effectively induces conductors on its surface which have a feeble relative velocity.

He laid on a table a rectangular multiplier, connected in circuit with a galvanometer. The multiplier was revolved and the needle of the galvanometer was deflected. From this experiment M. Quet concludes that at every point of the globe the induction of conductors in relative movement produces sensible effects when the speed is about 0·1 metre per second, provided that the direction of that velocity does not make too great an angle with the inclined needle. As the movement of rotation common to the earth and the conductor does not give rise to induction, it can be eliminated altogether from the problem, and the relative velocity be regarded as the absolute one.

Admitting, then, that the earth and the sun have the same magnetic distribution, so that at the same latitude and longitude on both surfaces the declination, inclination, and magnetic intensity are equal upon the two surfaces, it is clear that two equal conductors will experience equal inductions if they are placed at two corresponding points on the two surfaces while being animated with equal relative velocities and inclined at the same angle to the direction of the magnetic lines. The conductor, which will move on the solar surface with a relative velocity of 0·1 metre per second, will therefore experience a sensible induction.

Imagine a radius sector from the centre of the sun to the centre of the earth, and the conductor placed on this radius by turns at the surface of the sun and the centre of the earth. In these two positions it will move parallel to the direction which the globe follows, and it will have upon the sun a relative velocity of 0·1 metre per second, and in the globe a velocity equal to that of the earth. It becomes a question of comparing the two electromotive forces produced under these two conditions.

In general the electromotive force produced by the sun upon a conductor, and due to the velocity of the conductor, is proportional to the product of three quantities—the magnectic force D of the sun at the point where the conductor is, the velocity V of this moving body, and the sine of the angle d that the direction of the motion makes with that of the magnetic lines. Its value is given by the formula

$$F = \frac{K D V \sin. d}{2}.$$

Upon a similar radius sector drawn from the centre of the sun, the magnetic force which remains sensibly parallel to itself varies nearly in proportion to the inverse cubes of the distances. It is therefore much enfeebled when the distance is great. But that does not prevent the electromotive force taking a notable value; it suffices, in fact, that by compensation the velocity becomes great enough. This force will not even change if the

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velocity remaining parallel to itself varies in direct ratio to the cube of the distances.

If the conductor placed at the earth's centre had an absolute velocity of 0·1 metre, the electromotive force that it would experience would be 9,887,158 times feebler than at the surface of the sun, that number being the cube of 21,468, and the distance from the earth to the sun being 21,468 solar radii. Its electromotive force will remain the same as that on the sun if its velocity becomes 9,887,158 times 0·1 metre, or 988715·8 metres. As this last velocity is about thirty-two times greater than that of the earth, it follows that the conductor will experience an induction thirty-two times less than a force whose effects are rendered sensible by experiments made on the earth. It is, therefore, itself a sensible force.

We arrive at an analogous conclusion, if to the corresponding points of the earth and sun, the declination and inclination remaining the same, the magnetic intensity is 2·3 times feebler upon the sun than the earth. When it is considered that in M. Frecul's experiment he was able very notably to diminish the velocity of rotation of the multiplier without the deviation of the needle ceasing to be sensible, we may conclude that the induction of the earth by the sun could only be insensible if the magnetic power of the sun was much inferior to that of the earth. So great a feebleness of magnetic power on the sun is not probable; on the contrary, it is natural to suppose a great magnetic power in a star which displays an energy so enormous.

By this kind of reasoning, and without being obliged to frame a hypothesis, it can be seen that the induction of the moon, due to its revolution round the earth, gives rise to an electromotive force twenty-one times smaller than that whose effects are rendered sensible by an experiment on the earth, and which, consequently, is itself sensible, and in M. Frecul's opinion would give rise to a diurnal variation of compass-needles regulated by lunar power.

FITZGERALD'S MAGNETO AND DYNAMO-ELECTRIC MACHINES.

The improvements in magneto and dynamo-electric machines we now illustrate deserve the most careful attention, inasmuch as they show a decided advance in the right direction. The main idea of the inventor seems to have been to aim at perfecting the Gramme machine, and so, instead of rotating the ring between the poles of a magnet on the ordinary system, he wholly or partially surrounds the ring both longitudinally and transversely, thus increasing the effective inductive action. The ring is thus magnetised directly, and with the least possible loss, and the direction of the inducing magnetic polarity is in the circle constituted by the ring itself, as it should be. Fig. 1 shows a transverse sectional elevation of a dynamo-electric machine, Fig. 2 is an elevation partly in section looking on to the left hand side of Fig. 1, with the driving pulley removed. In Fig. 1 A is the soft iron ring carrying 60 (more or less) coils, B, of wire, all wound in one direction. The ends of these wires are connected to the collector C. The ring A, with its coils, is mounted on a disc, D, attached by a boss, E, to the shaft F, mounted in suitable bearings on the standards G·G, and at one end carrying the driving pulley H. The ring A is almost wholly surrounded by a hollow electro-magnetic ring I I^1 I^2. For convenience of manufacture the ring I I^1 I^2 is divided into several portions, of which the two represented by I^1 and I^2 are annular, while two are semi-annular, and make up the largest diameter I, the division between the halves being preferably at the top and bottom. The separate portions of this hollow magnetic ring are so wound with coils of wire as to constitute two magnets having their like poles opposed on the vertical plane transverse to the ring A. The reverse direction of the winding near the poles required to produce this effect is shown at Fig. 3. The various sections of the electro-magnetic ring are united and held in position by thin lugs, J, projecting from their cores between the coils of wire. These lugs J are bolted to other lugs, K, cast on the frame L. The ring A has preferably a deep recess, *a*, cut in it circumferentially, as shown. The collector, C, consists of a cylinder of wood or other non-conducting material rigidly attached to the boss E, and having let flush into its inner circumference a series of strips of conducting material, M, insulated, and in number equal to the coils on ring A. The extremities of the coils are brought to the outside of the collector, and connected so as to form a closed circuit, the points of connection between adjacent coils being severally brought into contact with the conducting pieces M as shown at *m m*. Fig. 4 shows clearly the collecting brushes, the current being taken off at the horizontal central line, or the line of greatest polarity. Fig. 4 also shows a front view of the collector C. The brushes are flat springs of copper, O′, each having at one end a contact piece, O, and being attached at the other end to a round bar, P, passing through a terminal, Q, and being fixed in position by a set screw, R. A short lever, S, is fastened to the end of the bar P, having an adjusting screw, S′, tapped through it, and bearing on the plate underneath. This screw enables any required tension to be put on to the springs O′, thus regulating the contact friction. The terminal Q is fixed to and insulated from a plate, T, connected by screws, U, to the end standard of the machine. The whole of the current-collecting portion of the machine is liberated by means of these screws.

Considerable modifications are made in the construction of the ring. The method of construction is shown by Fig. 5. Ordinarily, in winding a number of coils of wire upon a ring, more especially if it be of circular section and if the number of turns of wire be the same in each layer, interstices are left between the coils. These interstices are filled by Mr. FitzGerald with soft iron wedge-shaped blocks, V. These blocks can either be made with the ring, or separately and slipped on, the ring being made in halves to receive them, as shown.

Fig. 6 shows a modified form of the ring A and the encircling magnets I I^1 I^2 the ring being cylindrical instead of circular, and the encircling magnets having modified shapes to correspond. The principle is the same whichever form is used. Figs. 7 to 10, however, illustrate a modification in which the ring A is wholly encircled on its cross section by coils, W, in lieu of inducing magnets.

Figs. 7 to 10 illustrate a totally new form of machine, in which the ring A is wholly encircled on its cross section by coils, W, of wire in lieu of inducing magnets. These encircling coils W are supported in a suitable framing, X, and the ring A, to rotate through them, is mounted between three or more rollers, Y, by one of which (preferably the upper) it is driven by frictional contact, the surface of this roller or pulley being of india rubber, as seen at *i i*, Fig. 8. The extremities of the coils of ring A are attached in a manner similar to that before described to a series of strips of conducting metal, Z, let flush into the external surface of an ebonite or wooden ring, A^1, fitted round the outside of ring A. The current is taken off at an aperture in the outer circumference of the coils W left in each between the coils of wire. Preferably, the coils W are wound so as to leave a longitudinal groove, W, on their inner surfaces, where they pass over the ring A^1 on the outside of ring A. This allows of the two surfaces of the ring and encircling coils being brought into very close contact. Fig. 8 is a transverse section taken at *a b*. Fig. 9 is a sectional plan of ring A at centre-line, and Fig. 10 a section of coils W, taken at line, *c d*, Fig. 7.

It is obvious that in the three forms of machines shown permanent magnets may be substituted for the electro-magnets, the permanent magnets retaining substantially the same shape, but being necessarily divided at the points where their similar poles are opposed.

The coils on the ring A and those on the inducing electro-magnets I I^1 I^2 (or the inducing coils W), may be connected in multiple arc or in series, as is well understood. The apparatus may be advantageously constructed in duplicate, the current from one of the rings A being employed to magnetise both of the hollow electro-magnetic rings and the current for the external portion of the circuit being taken from the second in ring A. The coiled ring A may be enclosed in a casing of soft iron provided with a circumferential slot to allow of the passage of the wires from the coils. The arrangement of the inducing magnets I I^1 I^2 and the coils W is applicable to ring-armatures generally. The saddle-back magnets—as they are called by Mr. FitzGerald—of double or single curvature, are applicable to a great variety of purposes. The claims of the inventor are:—(1.) In dynamo or magneto-electric machines the combination with a ring or cylinder-shaped armature of permanent or electro-magnets of double curvature, such as will encircle the ring-armature both longitudinally and transversely. (2.) In similar machines the combination with a ring or cylinder-shaped armature of an electro or permanently magnetic ring constituting two magnets having their similar poles in a plane transverse to the ring-armature. (3.) In similar machines the combination with a revolving coiled ring or cylinder of stationary inducing coils completely encircling the revolving coiled ring or cylinder. (4.) The method of constructing dynamo and magneto-electro machines as described. (5.) The construction for use in dynamo or electro-magnetic machines or in other electrical apparatus of magnets illustrated in Figs. 1 to 6 of the accompanying drawings, the essential characteristic of such magnets (termed saddle-back magnets) being that they are always curved in the direction transverse to the axis of the magnet (or the line joining the poles), whilst they are sometimes curved also in the direction of this axis, and in the case of electro-magnets are surrounded with coils of wire every turn of which is partly convex and partly concave.

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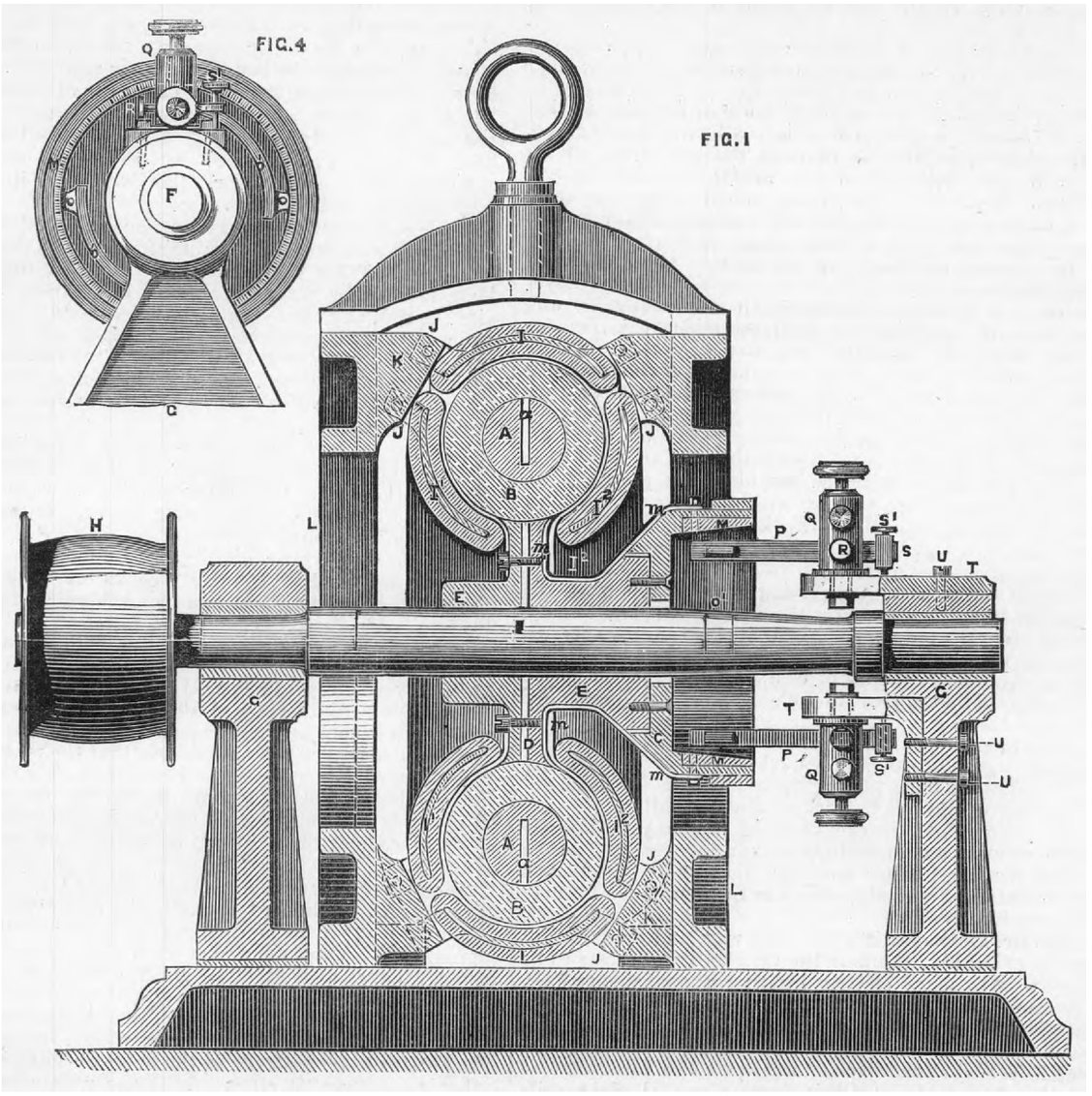

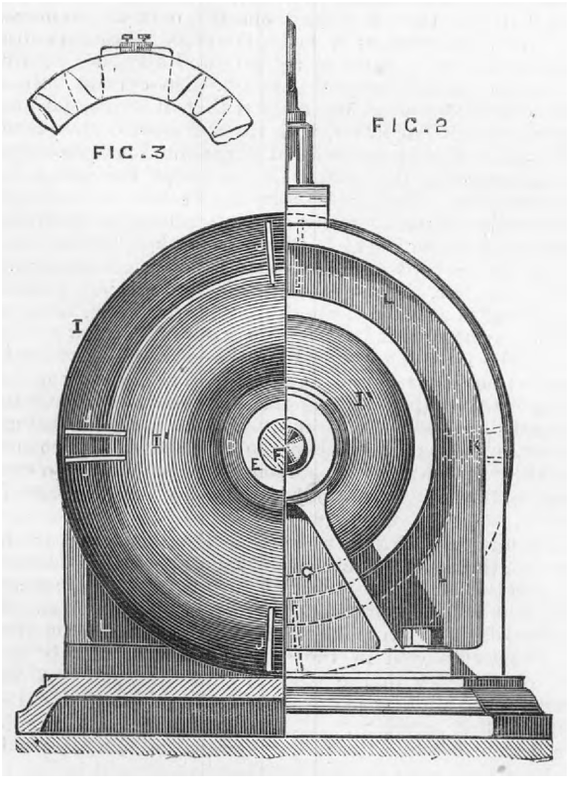

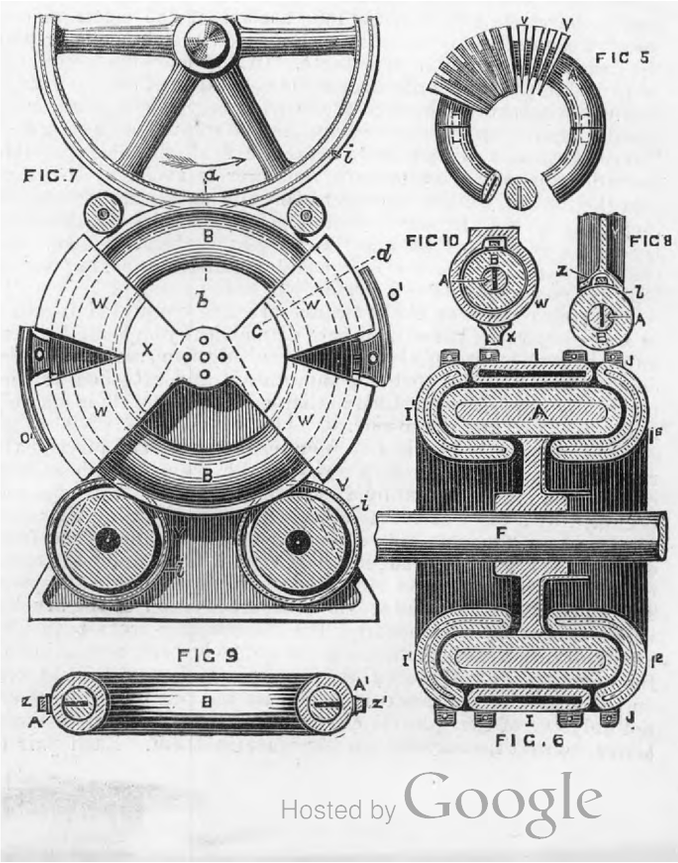

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PROGRESS AND COST OF ELECTRIC LIGHTING IN AMERICA.

BY PAGET HIGGS, LL.D.

The chief system of electric lighting in use in America is that of Mr. C. F. Brush, a system that has extended to England. Next to this system, in number of machines employed, stands that of Mr. Weston, followed by the Maxim, Hockhausen, and other systems. Not a single European system appears to meet with favour on this side the Atlantic, at least the writer cannot learn of more than a single application.

Of the Hockhausen machine it is difficult to obtain descriptions. The Maxim dynamo-electric generator, used and advocated by the United States Dynamo-Electric Generator and Light Company, in appearance exactly resembles the Siemens machine as known in England, as also does the Weston machine, both differing similarly in construction of the revolving cylinder and of the commutator. In each case the coils of wire are separated by narrow strips of iron, projecting to a level with the outside of the coil; and the conducting pieces on the commutator, instead of running parallel with the axis of the armature as in the Gramme and Siemens machine, are placed at an angle, to ensure contact with the next section before contact with the section under action is broken. Both these machines appear intended to furnish a light with a short and thick arc, or, in other words, to generate a quantity current, currents of such a nature of course necessitating the placing of the lamps near the machines or the use of thick conductors, and preventing the successful use of more than a very limited number of lamps on a single circuit. With neither of these machines has the writer succeeded in obtaining data as to cost of the light per hour, although both machines appear to furnish powerful lights. In alterations that are in progress in the city of Boston some five Maxim lights are employed, obtained from separate machines, at apparantly an expenditure of about 1 h.-p. for a thousand candles. These lights burn all night, and enable the men engaged in building operations to work continuous shifts.

About the Edison light in the point of economy nothing is known, as there has been no continuous nor independent public display. The Wallace-Farmer machine, that under Mr. Ladd's able direction obtained a good position in London, is here nearly unknown in practical work.

Practically Mr. Brush has it all his own way, and the powerful corporation working his patents in the various States seems to be fairly on the road to make electric lighting a permanent affair. The Brush machine and lamp both possess considerable novelty. The armature consists of a soft cast iron flat ring, revolving in its own plane. This ring is composed of two parts, each grooved and insulated from the other, so as to prevent the formation of Foucault induced currents. On this ring are wound eight coils of armature conductor. Field magnets of opposite polarity are applied to diametrically opposite points of the annular armature, and as these field magnets are applied to both sides and very nearly the whole length of the long armature, the electromotive force of the current obtainable with a given resistance is greater than with other annular armatures. In the machine supplying 16 to 18 lamps on a single circuit the resistance of the armature conductor, measured through the brushes on the commutator, is about 4 ohms; and when the armature is rotated at a speed of 750 revolutions a minute in its magnetic field, the electromotive force developed in the armature conductor is sufficient to maintain the normal volume of current through an external resistance, including the field magnets of the machine, of fully 80 ohms, or through a resistance twenty times greater than its own. No other dynamo machine shows equal results of working on so high resistance of external circuit.

The coils of wire on the armature are not connected together in a single circuit, but each pair of diametrically opposite bobbins only are connected together. The resulting two free ends of the conductor are carried to the commutator, and attached to diametrically opposite segments, so that each pair of coils is entirely independent of any other pair.

The commutator consists of four separate rings of metal, each ring consisting of two nearly semi-circular segments, whose ends on one side are separated by a considerable space. This space is occupied by a piece of metal attached to an adjoining ring, and known as an "insulator." It is insulated by an air-space from each of the segments between whose ends it is located; the other ends of the segments are separated simply by a single air-space. The office of the "insulator" is to separate either of the brushes which collect the currents from the commutator from both segments during a certain interval, and twice in each revolution of the commutator. During these separations the two coils of wire on the armature that are connected with the pair of segments are not only out of the general circuit, but are open-circuited themselves, so that no current can circulate in them. Each pair of coils on the armature is thus provided with a commutator ring, and the segments of this ring occupy the same angular position with regard to the other segments that its coils occupy with regard to the coils attached to the other segments. This arrangement of the commutator admits of the use of oil for lubrication.

The Brush lamp contains several important improvements that conduce largely to the general development of the electric light. It was the first to use the so-called differential or shunt-magnet system, claimed for some European inventions. The lamp contains no clockwork.

The movement of the upper carbon, actuated by gravity, is controlled by an annular clamp that surrounds the rod carrying the carbon. When the lamp is in operation one side of this clamp is lifted by magnetic action; this causes it to grip and raise the rod, and thus separates the carbons. As the carbons burn away the magnetic action diminishes, and the clamp would move gradually downward; when the tilted annular clamp finally touches the supporting floor from which it started, any further downward movement releases the rod, and allows it to slide through the clamp.

Each magnet helix is first wound with a few layers of coarse wire, through which passes the main portion of the current operating the lamp. Over this coarse wire is wound a very much greater length of fine wire, having its end connected with the terminals of the lamp, but in such a manner that the electric current shall pass through it in a direction opposite to that in the coarse-wire helix. The fine wire forms a shunt circuit of high resistance through the lamp, and this circuit is independent of the arc, and is always closed. It follows from the difference in direction of the current in the two helices that the fine-wire helix will constantly tend to neutralise the magnetism produced by the coarse-wire or principal helix. The number of convolutions of the fine-wire helix and its resistance are so proportioned to the number of convolutions in the principal helix and its resistance, together with that of the normal arc, that the magnetising power of the latter shall be much greater than that of the former; but notwithstanding the small amount of current passing in the fine-wire helix (about one per cent. of the whole current) its magnetic power is considerable, owing to the greater number of convolutions.

When the arc increases in length beyond the normal condition more current is shunted through the fine-wire helix, and the resultant magnetism is diminished, allowing the carbons to approach, the opposite action occurring under opposite conditions. Thus, although the general strength of the current operating a larger number of lamps does not vary, each lamp performs its regulating functions through the agency of varying magnetism as though it were the only lamp in operation.

In practice the resistance of the fine-wire helix in each lamp is rather more than 450 ohms, whilst the resistance of the coarse wire, connections, carbons, and arc is about 4½ ohms.

Each lamp carries a short-circuiting device or cut-out mechanism to guard against general extinction from the inoperation of or accident to one or more lamps. It consists of a small magnet core surrounded by a coarse and a fine-wire helix, similar to those of the working magnet. No current passes through the coarse wire until the magnet that it surrounds has raised the armature. The latter, with the coarse wire, then form part of the short circuit established through the lamp. The fine-wire helix is put in the circuit of the larger fine-wire helix previously described. During the normal operation of the lamp, this fine-wire helix magnetises the core, attracting the armature with a certain force insufficient to lift it. But when, through the exhaustion of the carbons in the lamp, or from their failing properly to feed together, the arc is lengthened too much, a greatly increased current is shunted through the fine-wire helix, the iron core raises the armature and establishes a circuit of low resistance through the lamp independent of the carbons. Evidently when the short circuit is closed as described, very little current circulates in the fine-wire helix, and the magnet would drop its armature, and thus open the circuit, were the armature not retained by some means other than the magnetism due to this helix; but the coarse-wire helix surrounding the same iron core is now brought into use, and by this means the armature is retained.

When it becames desirable to operate the lamps more than eight hours continuously "double-rod" lamps are used. In each of these lamps two movable rods, and two sets of carbons are employed. The rods are placed three inches apart, and each is moved as described. Both rods are actuated by a single magnet, the same as that employed in the single rod lamp. The lifting mechanism connected with the magnet is so arranged that one of the rods is lifted slightly in advance of the other. When the electric current first passes through such a lamp the two carbons divide the current between them, but as soon as one carbon is separated by the action of the magnet the whole current is thrown

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	——	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	North Sea.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	St. Pierre.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	——	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

through the other. When the continued action of the magnet separates the remaining pair of carbons the arc appears, and the light is established. The clamp that was the last to raise its rod becomes the first to release it, so that the carbon first set in consumption remains in circuit till consumed, when the other comes into play. By introducing three rods the lights may be maintained as easily and certainly for twenty-four hours. It should be noted that in no case is personal attendance required; the user has but to insert the carbons, and the lamp is ready for and maintains action until they are consumed. This improvement is clearly a very marked one in electric lighting.

(TO BE CONTINUED.)

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

Report of the directors for the half year ending 30th June, 1880, to be presented at the general meeting of shareholders, to be held on Thursday, the 30th September, 1880. The annexed accounts for half year ending 30th June, 1880, show a balance to the credit of profit and loss account of £3,559 13s. 3d. As the Bilbao cable was interrupted during the first 2½ months of the half year, the traffic receipts (£5,573 17s. 11d.) may be considered satisfactory. The cables of the Company continue to work perfectly, and their electrical condition is as high as ever. In consequence of arrangements with the postal telegraphs, it has been decided to exchange traffic with the department at Falmouth, instead of at the Lizard, and an underground line is being constructed by the Company between these two points. This work is being executed at a comparatively small cost, as some cable recovered from the Bay of Biscay last year, and suitable for this purpose, is being utilised. As will be seen by the accounts, the cost of repairing the Bilbao cable was £5,209 13s. 3d., and has necessitated the withdrawal of £759 10s. 10d. from the reserve fund. The accumulated dividends on the preference shares up to 30th June amount to 20s. per share. The balance of £3,559 13s. 3d. at the credit of profit and loss enables the directors to recommend that 10s. per share thereof be paid, and that £638 3s. 3d. be added to the reserve fund, which will then amount to £2,078 12s. 5d. The next remittance from the Spanish Government, for the June quarter, is expected at the beginning of November, when the dividend warrants will be issued to the preference shareholders.

ABSTRACT OF PATENTS.

5114. Facilitating Telephonic Communication, *W. R. Lake.—Dated 13th December*, 1879—(*A communication.*) 8*d*.

Electricity and electro-magnetism are employed to enable all the operations of the central office to be carried on automatically, that is to say, any member may communicate with any other member whose line is unoccupied, at the same time he can isolate his own line if he desires to communicate with from all others; he is enabled to signal the member to be communicated with and receive the answering signal, and while these two are using their lines all the other members can be using their lines, two and two, without in any way interfering line with line.

5119. Electric Telegraphs, *Sir J. Anderson, Kt., and F. S. Harwood. Dated 13th December*, 1879.—(*Void.*) 2*d*.

This relates mainly to means for increasing the speed of signalling through submarine telegraph cables and covered land lines when working "duplex."

5126. Electric Signalling Apparatus for use in the Loading and Unloading of Ships, *W. White.—Dated 15th December*, 1879.—(*Not proceeded with.*) 2*d*.

The apparatus comprises an electric alarm bell of ordinary construction and recording arrangement, which is fitted in a wooden box in the engine room or other convenient situation near the engine-man or other attendant, and is connected by separate insulated wires with a communicator or contact-making apparatus to be held in the hand of the person in charge of the loading operations.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Sept. 22.		Business Done Week Ending Sept. 22. Highest.		Lowest.	
Anglo-American Ordinary	64⅛,	65		65⅝		64⅛
Do. "B"	95½,	¾		96¾		95¾
Do. "A"	35½,	36		36⅞		35½
Brazilian	9⅜,	½		9 7-16		9⅛
Cuba	9⅛,	¼		9 9-16		9⅜
Do. Ten per Cent. Pref.	16½,	¾		—		—
Direct Spanish	1⅜,	2½		—		—
Do. Ten per Cent. Preference	11⅜,	12½		—		—
Direct United States	12½,	¾		12⅞		12½
Eastern	9⅞,	10		10		9¾
Do. Six per Cent. Debenture	106,	109		108		106½
Do. Five per Ct. do. 1899	103,	106		105		103
Do. Six p Ct. Pref.	12½,	¾		12¾		12⅝
Eastern Extension	10⅛,	½		10⅝		9 15-16
Do. Six per Ct. Deb	108,	110		109		108
German Union	9⅛,	¾		9⅝		9⅜
Globe Telegraph & Trust	6 13-16,	15-16		6 15-16		6 11-16
Do. Six p Ct. Preference	12 3-16,	5-16		12⅜		12⅛
Great Northern	9⅞,	10⅛		10		9 15-16
Indo-European	25,	26		25¾		25½
Mediterranean Extension x d Sept. 16	2⅞,	3⅛		—		—
Do. Eight p Cent. Pref. x d Sept. 16	10⅜,	11		11¼		10⅞
Reuter's	10,	11		—		—
Submarine	242,	247		243		243
West India and Panama	1 5-16,	7-16		1½		1 5-16
Do. Six per Cent. 1st Preference	7,	¼		7⅜		7¼
Western and Brazilian	7½	¾		7 11-16		7½
West. Union 7 p. Ct. 1st Mt.	120,	125		—		—
Do. Six per Ct. Sterg.	102,	104		103¼		103⅝

TRAFFIC RECEIPTS FOR AUGUST, 1880.

Companies.	Aug., 1880.	Aug., 1879.	Incrse.	Decrse
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,000 estd.	2,557	—	557
Direct Spanish Telegraph Company	1,197	996	201	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	42,988	36,257	6,731	—
Eastern Extension Telegraph Company	30,249	26,242	4,007	—
Great Northern Telegraph Company	22,800	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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Side Scuttles and General Brass and Copper Work.

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Ships' Cooking Hearths.
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IMPROVED TUG and LAUNCH ENGINES and BOILERS and GENERAL REPAIRS.

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Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
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TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby.

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SLIP

THE EASTERN EXTENSION COMPANY.—The next ordinary meeting is to be held at the Cannon-street Hotel, on Wednesday, October 6.

SELENIUM.—If the specific resistance of pure copper be taken as unity, that of selenium is about $3{\cdot}8 \times 10^{10}$, or thirty-eight thousand millions.

BUFFALO.—The Buffalo Telephone Exchange has 367 line wires in operation. Ten operators (females) are employed by day and five (boys) at night.

OVERHEAD WIRES.—An American contemporary thinks that while overhead wires are dangerous in one way, they may in another way act as preservatives against lightning.

DIRECT SPANISH TELEGRAPH CO.—It will be seen from the report that a payment of 10s. per share is recommended by the board, and that £638 be added to the reserve, making it £2,079.

TELEPHONY.—A Manchester correspondent states that rumours are current that the Government is seriously considering the advisability of purchasing the rights of the various telephone companies.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—Notice is given that, from the 1st of October next, and until further notice, the charge for the transmission of telegrams, "*viâ* direct cable," between Great Britain or Ireland and New York and Canada, will be 2s. per word. The existing rules will remain in force for the present.

THE JAMIN ELECTRIC LIGHT.—We hear that the new premises of Messrs. Samuel Bros., in Ludgate-hill, are to be lighted by means of twenty Jamin lamps. The arrangements for the electric illumination will be completed at the beginning of November, when the public will be able to witness the first exhibition of the Jamin light in London.

WEST INDIA AND PANAMA TELEGRAPH COMPANY.—The estimated traffic receipts of the West India and Panama Telegraph Company for the month ended the 31st August are £1,792, as compared with £3,877 in the corresponding period of 1879. The May receipts, estimated at £3,715, realised £3,777; and the June receipts, estimated at £4,017, realised £3,997.

BRAZIL.—A writer in the *Contract Journal* states:—"I hear from Brazil that the Western and Brazilian Telegraph Company is about to get a new concession for the cable service between Para and Cayenne, joining there with the United States cable. It is expected that a considerable part of the cable already down can be utilised, and that the outlay on restoration will not be heavy."

ANGLO-AMERICAN TELEGRAPH CO.—A French publication intimates that the joint purse arrangement between the three Atlantic cable companies is to be based on a proportion of 63 per cent. to the Anglo-American, 21 per cent. to the Direct United States Cable, and 16 per cent. to the French Company. The charges of the English companies are to be raised. This charge we notice in future is to be 2s. per word.

LITERATURE.—Mr. W. H. Johnson, editor of our American contemporary *The Operator*, is just about to publish a book entitled *Telegraphic Tales and Telegraphic History: a Popular Account of the Electric Telegraph, Its Uses, Extent, and Outgrowths.* In America people read, in England they lounge. In America "operators" have some *esprit de corps*, in England there is no bond of union, literary or otherwise. Why is this?

THE ILLUMINATION OF THE CENTRAL PARK AT NEW YORK.—It appears certain that the electric light will be employed for lighting this park, which is admitted to be at night a refuge for vagabonds and malefactors. It is pointed out that the laying of gas pipes would necessitate the mutilation of the roots of a large number of trees, and that the emanations from them would be most injurious to the plants and shrubs. The electric light would not only be free from these objections but would be considerably cheaper than gas.

EASTERN EXTENSION TELEGRAPH CO.—The company notify that the accounts to the 30th June last show (subject to audit) a balance of profit of £95,535 10s. 5d. for the half year. Out of this sum the board have already paid one interim dividend of 2s. 6d. per share, and they have just declared another of a like amount for the quarter ending June 30th; also a bonus of 1s. per share, payable on the 15th October, making a total payment of 3 per cent. for the half year at the rate of 6 per cent. per annum. A balance of £35,610 is carried forward.

A NEW GALVANOMETER.—M. L. Gostynski has brought before the Académie des Sciences a galvanometer specially intended for the measurement of thermo-electric currents. This instrument, according to the inventor, differs from all the known galvanometers in the fact that it is constructed with two astatic systems in the same direction. The deflections are stated to be proportionate to the full extent of the scale. The divisions on the latter, which is semi-cylindrical, are observed by means of a reflecting arrangement, part of which is constituted by a mirror attached to the astatic system.

TELEGRAPHY IN POLITICS.—*The Times* correspondent, writing from Gravosa on Sept. 25, says:—"Telegraphic intercourse between Scutari and Constantinople is incessant. Riza Pasha has a wire laid to his house, and communications are passing all day and all night. At one time for 48 hours the wires were occupied in this way, to the exclusion of all other telegrams, and great inconvenience was caused thereby." In short, we can hardly realise the important part played by telegraphy in modern politics, and it is sometimes doubtful whether the means of communication in the olden times were not more conducive to peace, inasmuch as it gave time for the "passions to cool."

THE FRENCH ATLANTIC CABLE.—In reference to this cable, *l'Electricité* says:—"If the news of the negociations for a fusion of the English Companies be correct, these negociations can but be the result of a capitulation on the part of the French Company. It is stated that the most favourable result of these negociations can only be to limit the losses of French shareholders to those already incurred. The most obvious result of this unfortunate affair will thus be to supply the English with an excellent cable at less than half the cost price. This is the more regrettable from the fact that, when subscriptions were called for, an appeal was made to the patriotic sentiments of capitalists."

EASTERN TELEGRAPH CO.—The company announce the payment of an interim dividend at the rate of 2s. 6d. per share, free of income-tax, on October 15 next, in respect of profits for the quarter ending June 30, 1880, this dividend being at the rate of 5 per cent. per annum. Last year, as between March, 1879, and March, 1880, the company added £87,337 to the reserve fund, raising it from £175,512 to £262,849. Assuming that anything over £100,000 placed to reserve in a year will be given as bonus or additional dividend over 5 per

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cent., it needs but between £12,000 and £13,000 to make up the £100,000 annual addition to reserve, and less than £38,000 more in a year pays 1 per cent. bonus. In other words, an addition of £51,000 of annual profits will suffice to raise the reserve to £100,000 a year and give 1 per cent. more dividend or bonus.

The Electrical Machine in Telegraphy.—The state of the atmosphere it is well known has a very great effect on the conditions for the electrification of the ink by the "Mouse Mill," in the Thomson recorder, and at most stations where it is used this is more or less felt. At Porthcurnow, the Eastern Company's station in England, where the damp fogs come up from the Atlantic, and saturate everything, causing the electricity to disperse, instead of being concentrated to the ink well, the trouble is sometimes very great. A lamp burning near is not effective. An electrical machine has been tried, a wire from the collector brought to the plate leading to the ink well, and it was found that a good and constant supply can be obtained, which causes the ink to flow well. Of course it necessitates labour to turn the machine, but this is compensated for by the fact that if the mirror were used this would also entail a writer, so that a greater number are not employed, and it does not generally last more than an hour or so.

The Duplexing of Lines between Great Britain and India.—The telegraphic communication between England and the Indian Empire is now in a state of thorough efficiency, the Eastern Company having duplexed their main lines throughout. The duplex system has been applied to the following sections:—Porthcurno and Lisbon, Porthcurno and Vigo, Vigo and Lisbon, Lisbon and Gibraltar, Gibraltar and Malta, Marseilles and Malta (two lines), Malta and Alexandria (two lines), Suez and Aden, Aden and Bombay. This gives an enormously increased capacity for business, and though the present daily traffic would a few years ago have seriously taxed the lines within working hours, the Indo-European and Eastern Company's cables have now a margin of capacity exceeding by many times the existing traffic. The efficiency of the staff also has kept pace with science, and we may mention that the daily average time for messages between London and Egypt is frequently only fifteen minutes, a result alike creditable to clerks and cables.

Canadian Energy.—A telegram from the Magdalen Islands says:—"During the week several vesssels from Quebec have arrived with telegraph poles. Sub-contractors are already at work, and posts are being put down at Amherst Island. It is expected that they will be in position by September 15. On the arival of the steamer "Newfield" from England, the cable end will be landed at the lighthouse on the southwest of the Island of Amherst, and from thence submerged a distance of thirty miles to connect with the east point of Prince Edward's Island. The "Newfield" is expected daily with the cable. The Bird Rocks will be connected with the island at the east point, near Grouse Isle, by submarine cable, twenty-one miles, and a telegraph line will be laid to follow thence around the island to the terminus, and the same will be dotted with the required offices. Mr. F. N. Gisborne has been on these islands superintending everything connected with the building of the line, in order that telegraphic communication may take place before the close of navigation, and then the Hon. P. Fortin's telegraphic system may well be said to be fully carried out. Thanks to his energetic measures and personal influence, these islands will cease to be separated from the Continent, as has ever been the case."

The Electric Light and Lanterns.—A recent number of *Le Gaz* thus sums up the principal defects of the most renowned systems of electric lightning:—"Jablochkoff Candle: Too much scintillation; no arrangement for relighting automically in case of extinction; too deep shadows beneath the lamp. Werdermann Lamp: Absorption of a great portion of the lighting power by the upper carbon; too frequent changing of the incandescent carbon; too much shadow. Jamin Candle: Too much noise; light too unsteady. Regulators—Serrin, Lontin, Brush, &c.: Too costly; too much shadow beneath; delicate manipulation." "Therefore," remarks our French contemporary, "there is still no really practicable system of electric lighting extant except the Serrin or Brush regulators for lighthouses or large works." Beyond this important negative result, the experience of four years working of the electric light in Paris, although aided by large subsidies, much financial support, and a certain amount of public favour, has produced absolutely nothing. We are inclined to think our contemporary is a little behind the times, and that a little keen appreciation of the progress recently made by Brockie, Crompton, Siemens, &c., in England, would enable one to place a different construction upon the existing phase of electric lighting.

Carbons.—Mr. Crompton, in his pamphlet on *The Electric Light for Industrial Uses*, says:—"The choice of these is almost the most important point of all, both for the perfect working of the machines as well as the lamps. It is quite possible for a machine and lamp to be seriously damaged by a bad carbon. Such a one having a point of great resistance in it far away from the arc, gradually heats up at that place and wastes away at a low red heat until eventually it breaks across and falls down, possibly short-circuiting the lamp, and if the machine is one giving a low tension current this occurrence is certain to cause heating up of the bobbin coils. Beyond this serious defect, which is almost impossible to discover by examining the carbons before they are put into the lamps, the carbons now in the market have, more or less, the following faults, those being the best that are freest from any or all of them. These are: first, high resistance of the carbon itself independently of the arc; second, being of soft texture, so that they are rapidly consumed; third, throwing down an ash as they are burned; fourth, giving coloured lights even when the arc is short; fifth, noisiness—hissing and spluttering; sixth, forming an irregular or badly-shaped crater even when arc is well regulated; seventh, giving abnormally long arcs for the current passing, such being caused by the evolution from the carbons of gases of high conducting power, such carbons make the arc into a kind of gas jet, and are impossible to regulate or to deal with in any way; eighth, want of straightness and regularity."

The Proposed Electrical Illumination of the Opera House at Paris.—Writing on this subject, M. Hospitalier says:—We may assert that the electrical illumination of the Opera will be *eclectic*, whenever it may be carried into effect: it is easy to show that this must be the case. The *façade*, the *loggia*, the entrance halls, &c., may, without inconvenience, be lit up by the Jablochkoff *bougie*, or any other; but this kind of light must be rigorously banished from the house and from the stage, for the Jablochkoff *bougie* and all the apparatus in which alternating currents are employed produce a certain sound which is more or less intense, but which is always inadmissible in a place where a *religious* silence is occasionally in the highest degree requisite. A journalist has happily characterised this peculiar rattling sound by comparing it to a *ballet of cockchafers*,

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The changes of colour, which have not yet been completely obviated, and the necessity for an automatic relighting of the house after *night effects* must also be taken into consideration. The lighting-up of the stage is effected at the present time by means of batteries, and of the regulator lamp of Dubosq, which is well adapted for the purpose. The batteries, however, might well be replaced by dynamo-machines. It should not be attempted to place regulator lamps in the house itself; their light is too powerful. The employment of the Werdermann lamp is in this case indicated. In the foot lights special qualities are requisite; and simple incandescence, of platinum or irridio-platinum spirals should, without too much regard to the expense, be in this case essayed.

Electro-Dynamics.—The new electro-dynamic law of Clausius, says *Science*, is receiving the deepest attention from the first electricians and mathematicians of Europe. The fundamental character of all his work and the acknowledged pre-eminence of his views, immediately demand an early investigation at the hands of his compeers. Already have Lorberg, Delsaulx, Frölich and others submitted this law to rigid analysis. This new law of Clausius was advanced by the distinguished author only after finding himself unable to reconcile the two laws of Weber and Rieman with that simplicity which overwhelmingly addresses itself to our reason; and because they seem too complicated to be used as explanatory of these molecular currents so felicitously employed by Ampère in his theory of magnetism. These laws of Rieman and Weber require us to believe in the existence of two equal and opposite currents as originating all electrical action. In another essential point, Clausius (*Annalen der Physic und Chemic X.*, 4, p. 609), finds himself compelled to differ from Rieman and Weber. They assume a relative motion between the electrified particles. Rieman using the word in its ordinary acceptation, according to which the difference of the components of velocity of the two electrical particles is made to represent the components of velocity of the relative motion; and Weber referring the relative motion to the mutual advance and retreat of the particles. Clausius rejects this method, which would confine one in the consideration of the subject to relative motion, and treats of both individual motions of the particles in their action on each other. In the same number of the *Annalen* is an article by Herr Budde, on the laws of Clausius, in which, as an adherent of the theory, he exposes the fallacy of Frölien's interpretation.

Chemical Magnetism.—It is a well-known fact, says the *Standard*, that there are persons occasionally to be met with so charged with electricity that when touched by any one a perceptible shock is communicated to the individual brought into contact with them. The most extraordinary case of this nature is undoubtedly that of a young lady residing in a Canadian town, who, if the statements made concerning her are to be relied on, is nothing less than a living battery. During two years she was an invalid, suffering from some mysterious complaint to which the faculty could give no precise name. She has now recovered and enjoys perfect health, but remains charged with electricity to an incredible degree. No one can shake hands with her without receiving a shock: if a persons puts his hand in a pail of water where hers is, the same sensation is felt. When hands are joined together she is able to communicate a shock to fifteen or twenty people assembled in the same room; and, besides, this remarkable young lady possesses the attractive powers of a magnet. If she stretches out her hand to take up a knife the blade attaches itself to her magnetic fingers ere she can grasp the handle; needles cling so tenaciously to her fingertips that she can do no needlework. When she enters a drawing-room every one present is at once susceptible of her influence; some fall asleep, others are seized with sudden indisposition; others are in a state of nervous agitation until she leaves the room. The lightest touch of her hand sends off a child, however fractious, into a deep sleep, and animals cannot resist her influence. A favourite dog of her parent's will, it is stated, remain for hours at her feet as motionless as though he were dead. If there is no exaggeration in the accounts given of this young electric American lady she is certainly a phenomenon, and were she in humble circumstances she might easily earn her living by simply giving *séances* of hand-shaking.

Telephone Convention.—The Americans, who have adopted telephony to a greater extent than we have hitherto in England, arranged a convention of managers, &c., to discuss affairs connected with this extension of electrical work. The session was held from September 7th to 10th, at Niagara Falls. The prime mover in this work was Mr. H. W. Pope, the General Superintendent of the Metropolitan Telephone and Telegraph Company of New York. The reports which have reached us of this meeting are rather meagre, but show that much useful work may be done at such meetings. Thus, Mr. E. M. Barton, of the Western Electric Manufacturing Company, of Chicago, in response to an invitation, addressed the convention on "Cables and Subterranean Systems," referring more especially to Brooks's system. He stated that Brooks's cable system consists in laying copper wires covered with cotton in an iron pipe, $1\frac{1}{4}$ inch in diameter, made tight and filled with paraffin oil under pressure. It has been tested experimentally for two or three years, and the cables laid at the earliest period are still in successful operation for telegraphic purposes. There were defects in some instances, but no cable laid during the past year has failed to work except where defects were caused by mechanical injury. The largest section in operation is from Camden to Philadelphia, in the Delaware River. The time devoted to using the Brooks cable had proved to Mr. Barton that an underground cable can be laid and operated, and at a cost not much greater than by stringing wires overhead. Other systems would doubtless be developed and rendered successful. He was convinced that cheap telephone wires could be laid and successfully maintained. Mr. Sargent reported that six hundred feet of the modification of the Brooks aerial cable, having over eighty wires, forty-two of which were working wires, was used successfully by his department in Philadelphia. Mr. Haskins, of Milwaukee, stated that they were using the gas pipe cables, and had never experienced any trouble with them. Then Mr. Fay, of Chicago, presented a long table of statistics, showing the extent of the plant and the cost of operating the Bell telephone exchange at that city. The Chicago exchange has 344 miles of trunk wires, 1,052 miles of exchange wires, 273 miles of private wires, a total of 1,666 miles. There are 1,633 telephone stations actually connected, 9 exchanges or central offices in different parts of the city, having a capacity of 2,334 wires. The exchanges make an average of 7,404 connections or conversations per day, which require, including trunk line connections, an average of 12,500 switches per day. During the first six months of 1880 1,429,406 of these switches were made by the Chicago exchange. The cost of making these connections at Chicago for the six months was 4 6-10 cents. a piece. This result was not considered satisfactory by the delegates, who thought that such a business was not likely to be profitable.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 209.)

LECTURE III.—DELIVERED FEBRUARY 16, 1880.

The powders most extensively employed for thus lowering the quality of rubber are the following:—Clay, chalk or whiting, French chalk or talc, barium sulphate, plaster of Paris, oxide of zinc, sulphide of zinc, sulphate of lead, various oxides of lead, oxy-carbonate of lead or white lead, magnesia, silica, and fuller's earth.

Some of the above-mentioned materials, specially prepared for the rubber manufacture, are shown in the collection of india rubber chemicals kindly lent to me by Messrs. Forster and Gregory, of Streatham; and these manufacturers also exhibit some qualities of sulphur specially purified for use in the vulcanisation of caoutchouc. It is a matter of considerable importance that the sulphur employed for mixing with caoutchouc should be free from all trace of acid, and also from the moisture which acid samples of sulphur tend to absorb from the atmosphere. Ordinary flowers of sulphur—prepared by passing sulphur vapour into large chambers constructed of masonry, so that this vapour shall condense into minute crystals resembling snow—is almost invariably acid in its reaction, as traces of sulphuric acid are formed by the oxidation of the sulphur. This acid may be removed by washing the flowers of sulphur with an abundant supply of water, and then drying at a gentle heat.

Here is a sample of ordinary commercial flowers of sulphur, and here is some of the same which has been washed and dried. I will put a little of each on a sheet of blue litmus paper, and then moisten them with alcohol. You see that where the unwashed sulphur was placed, the colour of the litmus paper is changed to red, owing to the action of the acid, while the colour of the limus paper has not been in any way altered by the washed sulphur. All samples of sulphur ought to be tested in this way before being employed for mixing with india rubber. Powdered roll sulphur is very often made use of, and it has not so much tendency to be acid as is the case with flowers of sulphur.

The so-called milk of sulphur—or precipitated sulphur—exists in a very fine state of division, and as far as this circumstance is concerned it is especially adapted for mixing with india rubber; but, on the other hand, it is expensive, and is liable to be damp.

All excess of sulphur in vulcanised rubber beyond that actually required is undesirable, but in order to ensure perfect vulcanisation it is necessary to employ considerably more than that which actually combines with the rubber. This excess sometimes effloresces out on the surface, becomes acid, and leads to the destruction of the rubber. It appears also sometimes so to combine with the rubber as to make it brittle and useless. In the case of articles presenting no great degree of thickness the greater part of this injurious excess of sulphur may be removed either by boiling them in a dilute solution of caustic soda or by means of a solution of sodium sulphite. Another method of producing vulcanised rubber which shall be free from any great excess of sulphur consists in replacing a considerable proportion of the sulphur originally mixed with the caoutchouc by a metallic sulphide.

The sulphide of antimony is that which is most extensively employed at the present time, the use of this having been claimed by Charles Hancock in a patent dated January 12, 1846; while in a patent dated February 10, 1847, he fully recognises the fact that free sulphur ought to be employed in conjunction with the sulphide of antimony. Sulphide of antimony for the rubber manufacture is prepared by boiling the native sulphide in a solution of caustic soda and precipitating the solution thus obtained with a slight excess of hydrocloric acid. Here is an alkaline solution of the native sulphide, and you see that when I add hydrochloric acid to it, an abundant orange precipitate is produced. This, when washed and dried, is ready for mixing with the caoutchouc.

The sulphide of antimony thus prepared contains, under ordinary circumstances, a certain proportion of free sulphur; but, in order to obtain the best result with the sulphide of antimony, it should contain as much as 20 or 25 per cent. of sulphur in an uncombined state. This can be insured by adding the requisite proportion of sulphur to the caustic soda in which the original native sulphide is dissolved. The well-known red rubber is vulcanised by means of the sulphide of antimony, and the superior qualities of this kind of rubber over the ordinary grey article are generally recognised by the public. The absence of any considerable excess of free sulphur renders it less liable to decay under the influence of time and light, while it is less subject to destruction by fatty matters than rubber containing an enormous excess of free sulphur. The quality of commercial red rubber is, however, somewhat variable, and I have met with samples which were scarcely vulcanised at all, the sulphide of antimony employed being probably deficient as to the amount of free sulphur present. When the sulphide contains from 20 to 25 per cent. of sulphur, it is generally not necessary to mix more than 15 to 20 per cent. of the sulphide with the rubber; but when a sulphide of antimony containing less free sulphur is employed, it is possible to add a much larger proportion to the rubber with advantage. No manufacturer should ever employ a sample of precipitated sulphide of antimony without first ascertaining that it contains a proportion of free sulphur suited to his work. Extra sulphur may be added in the form of milk of sulphur, but this proceeding is not so satisfactory as taking the right thing to start with. Other sulphides, such as lead sulphide, mercuric sulphide, or zinc sulphide, are occasionally employed as vulcanising agents; but, in order that they may act in the most satisfactory manner, it is necessary for some free sulphur to be present; and the amount of this free sulphur should always be exactly known, in order that the vulcanising may be a matter of certainty, rather than the result of a kind of haphazard guess work. Sulphide of mercury or vermilion intended for use as a vulcanising agent ought, in most cases, to contain as much as one third of its weight of free sulphur.

The action of these sulphides is peculiar. They have but little vulcanising action themselves, but they enable the free sulphur which may be present to exercise its full force; or, in other words, they take the place of that large excess of sulphur which remains ununited with the rubber in ordinary cases. Well, then, the use of these sulphides renders it possible to avoid the presence of a large excess of ununited sulphur in the finished goods. Some of the sulphides exercise by themselves a powerful vulcanising action; and among these may be mentioned the polysulphides of the alkalis and of the alkaline earths, as articles made of thin cut sheet may be very perfectly vulcanised by Gérard's process, which consists in exposing them to the action of a solution of the mixed polysulphides of calcium, at a temperature of about 140 degrees Centigrade.

Among Messrs. Forster and Gregory's specimens are many sulphides adapted for use as vulcanising agents, and others which are merely intended for use as colouring materials; these latter being, probably, free from any excess of sulphur. The fact of Messrs. Forster and Gregory being so well acquainted with the requirements of the rubber trade enables them to prepare sulphides suited for each particular kind of work. Among their specimens may be noticed the antimony vermilion, a very fine colouring matter, but not a vulcanising agent; the golden sulphide of antimony, which is specially prepared as a vulcaniser, and is manufactured in such a way as to ensure uniformity of composition, this being a matter of the greatest importance. Again, we have here yellow orpiment, a bright yellow colouring matter, which may be added to the rubber in any quantity, as it does not vulcanise to any appreciable extent; lead hydro-sulphide, a curing agent employed in the making of single texture goods; zinc sulphide, a white colouring matter, which may be added to the extent of 40 per cent. to the rubber; zinc oxysulphide, a white colouring material, which is sometimes used in the last coating on spread textures, as it possesses the property of absorbing sulphur, and so prevents sulphuring up, or an efflorescence of sulphur from the more highly sulphuretted layers beneath.

When articles made of thin rubber—let us say cut sheet—are imbedded in powdered sulphur, and exposed to a temperature of about 112° Centigrade for some considerable time, as much as 10 per cent. of sulphur is absorbed by the caoutchouc, and this absorption is facilitated by rubbing the powdered sulphur on the surface of the caoutchouc. This method of sulphuring cut sheets, and articles made from cut sheet, is of considerable practical utility in many cases, and the goods so charged with sulphur may be cured in the ordinary steam vulcaniser.

Parkes' cold curing process, briefly referred to in a previous lecture, is one of the neatest things existing in the whole rubber trade. Here is a piece of cut sheet rubber, which I now dip for an instant in a mixture of one part of chloride of sulphur and 40 parts of carbon disulphide; after which, I lay it for a minute on a tray covered with French chalk and heated to about 40° Centigrade. The portion which was dipped is now vulcanised; perhaps not all the way through, but very nearly. This method receives numerous applications, especially for the vulcanisation of articles made from cut sheet rubber. In this case it is probable that the chlorine removes hydrogen from the rubber, and that the sulphur takes the place of the removed hydrogen. A study of the process in question shows us how very minute is the

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proportion of sulphur actually concerned in vulcanisation. In Parkes' process we have one of the most perfect vulcanising processes existing, as combined sulphur alone reacts, and the finished articles are quite free from any trace of sulphur in an uncombined state. An after-treatment with water, or a weak alkaline solution, may be adopted to remove traces of hydrochloric acid. Light petroleum is now often employed in this process instead of carbon disulphide. Some hypo-sulphites, especially the lead salt, are capable of acting as vulcanising agents but are not very extensively made use of. Vulcanisation by hypo-sulphites is, however, interesting, as affording another instance of combined sulphur acting as a curing agent.

Other re-agents besides sulphur exercise a hardening or vulcanising action on india rubber; as, for example, nitric acid and the halogens. Warren claims the use of these latter bodies in his patent dated February 26, 1871, and he has very successfully vulcanised the insulating coating of telegraph wire by means of iodine. A piece of cut sheet rubber dipped into bromine becomes vulcanised instantly. Warren's process has been applied in America to the production of vulcanite bases for artificial teeth.

When sulphur and caoutchouc are mixed, there is a certain tendency for them to unite slowly, especially if exposed to the rays of the sun; a kind of gradual vulcanisation or curing being the result. This is very well exemplied in the case of the cork hat or helmets, manufactured by Messrs. Hawkes and Co., of Piccadilly, to whom I am indebted for this very complete set of specimens illustrative of their manufacture. The segments of cork, out of which these helmets are made, are cemented together by means of a solution of rubber in purified camphine, but a certain proportion of sulphur is added to the solution. During the time that the helmet is in use, the india rubber cementing medium gradually becomes vulcanised, increasing in toughness and hardness by exposure to the heat of the sun. If, on the other hand, no sulphur were present, the rubber would rapidly deteriorate, and the helmet would fall to pieces if used in a tropical climate.

I have to thank several manufacturers for lending me many of the numerous specimens of vulcanised rubber which are before you this evening, Messrs. Macintosh, Hancock, Davis, and Henwood, the Silvertown Company, and others having been most kind in this matter.

The remarkable power which vulcanised caoutchouc possesses of recovering its shape after compression is well illustrated by the fact that a sphere 2½in. in diameter passes between rollers set to a distance of a quarter of an inch without suffering any permanent injury as regards form.

Although vulcanised rubber is insoluble in the ordinary solvents of caoutchouc, boiling oil of turpentine will dissolve it, and sulphide of phenyl, a liquid discovered by Dr. Stenhouse, will soften it so far as to render it reworkable. Old vulcanised rubber reduced to a state of fine division can be incorporated with new rubber in many cases; and there are other methods by which waste vulcanised rubber may be utilised, as, for example, in the manufacture of kamptulicon, which will be referred to in the next lecture.

Oils and fats exercise a very destructive action on india rubber, more especially when the caoutchouc is unvulcanised, and through the kindness of Mr. T.S. Speck, engineer to the London District Railway Company, I am enabled to show you a very interesting specimen illustrative of this. It consists of a piece of one of the caoutchouc pipes employed to lead gas into the trains at the Hammersmith Station, and the pipe from which this specimen has been cut was placed in immediate proximity to the stopping point of the engines. You see how deeply and thoroughly the pipe is corroded and destroyed by the action of oil from the engines, while the other pipes in the station are in excellent preservation.

Some of the conditions which are favourable to oil resisting powers, in the case of vulcanised caoutchouc, are as follows :—

1. The use of a high quality of rubber.
2. Thorough curing.
3. The absence of free sulphur in the finished article.
4. The presence of such pigments as litharge, red lead, or white lead.
5. The incorporation of a trace of glycerine with the materials.
6. Curing in a glycerine bath. (Placed in an ordinary steam vulcaniser.)

On the table you will see some interesting specimens, kindly lent by Mr. Tuck; these illustrate the matter in question, and you will notice how well Mr. Tuck's special oil-resisting rubber has withstood the action of mineral and other oils.

Ordinary vulcanised rubber gradually deteriorates when maintained at a temperature near 130° Centigrade, becoming brittle and evolving sulphuretted hydrogen. This may be principally due to the reaction of the still uncombined sulphur on the caoutchouc. Exposure to the sun's rays will often produce a similar effect on caoutchouc containing free sulphur in considerable excess. Thus we see that, although both heat and exposure to light have a curing action on mixed rubber, the over-long continued action of either agency tends towards mischief.

(TO BE CONTINUED

REMARKABLE EFFECTS OF LIGHTNING.

During a storm which occurred in the neighbourhood of Paris on Thursday, August 19, there was a very remarkable display of fireballs seen by M. Frecul, who has described the phenomenon to the French Academy. The balls, or rather fiery tracts, which traversed the horizon were of an extraordinary size. Some appeared only as large as the hand, but others, which rose vertically behind the trees of the Place Jussien, Paris, were of a different character. The first that was seen by M. Frecul raised itself singly, and became extinct after it had reached a low height, evanishing in a magnificent spherical blaze, the light of which decreased in brightness from the centre to the circumference.

Other fiery pillars of the same sort vanished in a similar manner, but with different shapes of the terminal flame. On one occasion two of them rose simultaneously and parallel to each other at a distance apart. When they had reached a certain height they precipitated themselves toward each other in a direction exactly at a right angle to their former upright positions. They then tapered to a point at the end and went out, with neither deflagration nor noise. Probably they discharged into each other. M. Frecul thinks that these singular discharges hovered round the lightning rods of some neighbouring premises, but could not be quite sure, as night was coming on.

Another interesting effect of lightning is narrated by Mr. Johnstone in the Edinburgh *Daily Review*. On July 7, at 4:15 p.m., a lightning discharge struck the rock known as "The Dasses," overhanging the Hunter's Bog, in Edinburgh. This rock is of the fine grained basalt called whinstone in Scotland, and instead of striking the sharp, serrated crest of the crag, as might have been expected, it smote the flat, sod-covered top three feet behind the present edge, and detached several tons of rock over the precipice. Six blocks fell into the Hunter's Bog, the largest measuring four feet long by three feet broad, and one foot thick. Another fragment of rock now hangs in a precarious condition from the front of the crag. Moreover, the rock where the discharge took place is shattered into small pieces under the sod. It was on the sod that the lightning struck, and made a hole two feet six inches long, by one foot six inches broad. Singularly enough, on placing a compass near the hole made by the lightning, Mr. Johnstone found that the needle deviated from N. to E., and when the compass was in the hole the needle stood E.S.E. instead of N., "proving," according to Mr. Johnstone, "that the rock is still powerfully electrified at the spot where the lighting struck it." Except in the vicinity of the hole, the crag does not affect the needle. Perhaps Mr. Johnstone would have been more correct in his explanation if he had said that the basalt was rendered slightly magnetic by the discharge, a quality not uncommon among trap rocks, which are known in Canada and elsewhere to cause the surveyor's compass to deviate.

The electrical storm, which was cited some weeks ago, we find is not a new observation. In the Glasgow *Mechanic's Magazine* for Oct. 8, 1825, there is an account of an "Electrical Gale," which was encountered by the ship "Griper," Captain Clavering, 100 miles west of the Fiord of Drontheim, on Dec. 6, 1823. It lasted three days without a lull, and whereas it hardly affected the barometer during its approach, passage, or cessation, it seemed to have originated in a disturbed state of electricity in the atmosphere, for it was accompanied by very vivid lightning, unusual in winter in these high latitudes, and a continuance for several minutes at a time of balls of fire at the yard-arms and masts.

Touching the electric brush discharges which sometimes take place from the hair and fingers of men, and the coats of animals, as well as the leaves of trees, a recent note by M. Amat to the French Academy mentioned some curious facts which came under his observation out in Algeria, in 1876, between Djelfa and Laghouat, among the Atlas Mountains. He says that he has frequently drawn large sparks from the hair of his horse by means of a pocket comb. The best results were obtained in dry, warm weather, in the evening between 7 and 9 p.m. If the hair was a little moist, or the sky cloudy, no sparks or cracklings could be got. Animals, and especially horses, present in a higher degree than man the power of exhibiting these discharges. Travellers on the high plateaux of Central America have remarked that the coats of their horses discharge sparks under the brush or curry comb; and in South Algeria it is common to see the hairs of the tail so much alive with the electric forces that they diverge from the centre. On stroking the tail by hand distinct crackling sounds may be heard, especially during the day. One reason why man accumulates less electricity than the horse is perhaps that the horse is better insulated on his horny hoofs.

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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THE ELECTRIC LIGHT IN MINES.

It is noticeable that whenever we are shocked by hearing of an accident by explosion in a coal mine, some one, obviously ignorant of the subject on which he writes, suggests the use of the electric light instead of the ordinary safety lamp. In our issue of August 30, 1879, we dwelt at some length upon this subject, and pointed out that in fiery mines the temperature of all bodies in contact with the explosive mixture of gases must be kept below a certain point, or that means must be taken to keep oxygen from mixing with the fire damp. Now, it is absolutely essential that oxygen should be in the mine, for it is necessary to support life; therefore the latter method can hardly be adopted to prevent explosion. One of the most common methods used for the explosion of mixed gases in the laboratory is by means of an electric spark, this being far above the temperature required to bring the atoms within combining distance. It is evident, then, that the ordinary electric lamp could never be used in fiery mines; and we doubt very much if it would be safe to employ any of the incandescent systems which rely for "longevity" upon a vacuum. A perfect vacuum is difficult to obtain and difficult to keep; in fact, the difficulties in the way of devising an electric light apparatus for mining purposes are only realised by electricians who have a considerable knowledge of their subject. It is easy to suggest this or to suggest that, as it is always easy to talk, but to carry out the suggestion is another matter. A correspondent in *The Times* recently suggested the use of vacuum tubes, and hinted that the matter was exceedingly simple. A battery and a coil was all that would be required. If the tube broke the light was gone, and danger obviated. The writer's experience with induction coils differs somewhat from ours, but then it may be that he or she has only read of such things, and not handled them; or, perhaps, the suggestion would be for the coils to be at the surface, with connecting wires to each lamp—an idea evidently impracticable. In order to obtain perfect security, we should, among other things, require a lamp impenetrable to gases, not liable to be broken, contacts that would never require to be moved, wires perfectly insulated, so that contact was impossible, &c. Just consider for a moment the ordinary method of joining a lamp in circuit by putting the wires into binding screws. How often is this done without obtaining "sparks," and if such sparks occurred in a fiery mine, how should we avoid an explosion? Last year we heard of the system of MM. Cebrian and Molera, who suggested the use of reflectors and pipes to direct, and, so to speak, carry the light to the point required. If it were possible to fairly perfect such a system at a cost at all commensurate with its value, it would be the plan to use in mining purposes. The motor to drive the dynamo or magneto machine could be placed, together with the machine, at the pit's mouth, in a position whence no harm could arise. The light being generated in safety could, by such a system of reflectors and tubes as might be required, be transmitted down into the pit, with the absolute certainty that no explosion would occur, for so far as we know no case has yet happened where gases susceptible of entering into combination by the effect of light have been set free in coal mines.

Of course the great question in considering the subject of lights in mines is, can we get perfect safety? and the next question, at what cost? The system of Cebrian and Molera might at least obtain a trial, and, if ten or twelve mine owners were to share the cost of an experiment, the amount in each case would not be great, and the question would be settled. So far as we can gather, the idea of the writer in *The Times* is to have a portable, and not a fixed or partially fixed apparatus. The exact words used are "A small portable coil, bichromate of potash battery, and tube would be sufficient; while as to safety, the breakage of the tube would occasion the simultaneous extinction of the light, for the vacuum is the condition of its existence." We have felt constrained to call the attention of electricians to this matter; because the public, not understanding the difficulties of the question, will probably conclude that we are apathetic, and that, whilst our knowledge would enable us easily to design apparatus, we are negligent and do nothing. The question of safety from explosion in mines is one so important that, if any reader feels he holds the clue to the solution of the question, he is, we think, bound to discover it at the earliest opportunity.

CABLE SHIPS.

In the Board of Trades' International Steering and Sailing Rules, which came into operation on the 1st September, 1880, is the following regulation which, we fear, may be the cause of serious mischief to the very class of vessels it is intended to protect.

Article 5. "A ship, whether a steam ship or a sailing ship, *when employed either in laying or in picking up a telegraph cable, or which from any accident is not under command*, shall at night carry in the same position as the white light which steam ships are required to carry, and, if a steam ship, in place of that light, three red lights in globular lanterns, each not less than 10 inches in diameter, in a vertical line one over the other, not less than three feet apart; and shall by day carry in a vertical line one over the other, not less than three feet apart, in front of, but not lower than her foremast head, three black balls or shapes, each two feet in diameter.

These shapes and lights are to be taken by approaching ships as signals that the ship using them is not under command, and cannot, therefore, get out of the way. The above

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ships, when not making any way through the water, shall not carry the side lights, but when making way shall carry them."

It is hard to imagine any two cases more dissimilar than those to which this rule is intended to apply. In the first, that of a telegraph ship laying or picking up a cable, but especially when picking up, it is of the utmost importance that she should not be disturbed, and every cable captain will testify to the annoyance and anxiety he has undergone from steamers bearing down upon him at night in the hopes of salvage. There are many circumstances under which a telegraph ship at work is not under way, and may be, according to this regulation, hopelessly broken down as far as any outsider may know, judging from her lights. Take for example the lifting the bight of an old cable in deep water or the making of a final splice, during either of which operations the slightest movement of the ship may ruin weeks of constant labour and anxiety, and cost thousands of pounds. We have frequently known cases where, during these delicate operations, steamers in the offing have altered their course and borne down on us, passing close enough to throw a line on board. The risk was quite great enough before, but for a vessel under such circumstances to hoist a signal that may also mean she is broken down is simply to invite the very danger she wants most to avoid. Further than this, the risk is not confined to the telegraph steamer only, but extends to any vessel approaching her. Buoys and mooring ropes are a fertile source of danger, for sometimes a ship may have several out at a time, and a steamer running one down would be very apt to entangle her screw. The same applies to laying a cable in deep water, the line after leaving the ship's stern makes a very small angle with the water, and any steamer crossing within say a quarter of a mile of her stern would be almost certain to foul the cable, probably breaking it, and fouling her own propeller.

We hope that some of the more influential companies will memorialize the Board of Trade on the subject, and that a new regulation will be passed which will remove this fresh source of danger from the already sufficiently perilous life of submarine cables.

HISTORICAL MEMORANDA ON SUBMARINE TELEGRAPHY.

BY F. C. WEBB, M.I.C.E., M.S.T.E.

A complete and correct history of submarine telegraphy would be difficult to write, for many reasons; but the author has thought that the following memoranda, in which he has endeavoured to place before the reader some of the most salient points in the history of submarine telegraphy, may be of interest. No doubt it will be found very incomplete, but perhaps some of those who peruse it may be able to supply the missing links, and will take the trouble to publish them for the benefit of those who feel an interest in the subject:—

1839. Dr. W. B. O'Shaughnessy constructed a line of telegraph in India, twenty-one miles in length, in the vicinity of Calcutta, embracing 7,000 feet of river circuit. (See "The Electric Telegraph in India." 1853.)

1849. On the 10th of August a concession was granted to Mr. Jacob Brett for the establishment of a submarine telegraph between England and France for ten years, provided that satisfactory experiments were made before the 1st of September, 1850.

1850. Accordingly it was determined to lay down an unprotected gutta percha-covered copper wire between Dover and Cape Gresnez to save the concession. This wire was a solid copper wire, about No. 14 gauge, and covered with gutta percha, to about half an inch diameter. This was manufactured at the Gutta Percha Company's Works, Wharf-road. Mr. Wollaston was the engineer in charge of the work. A large cast iron reel was made for winding the wire on, but this proving too heavy, a lighter one was made by Mr. Reid out of a spar of wood, with end discs of cast iron. These end discs had a break strap to check the drum from unwinding faster than desired. The reel was placed on suitable bearings athwart ship on the deck of ss. "Goliath," just abaft the funnel. On the taffrail was a small wooden roller, without any guide to keep the wire on it. Flat lead weights, about eight inches square, with a groove running diagonally across them, and with two holes cast in half of them, and two rivets on the other half were provided, to be rivetted on in pairs to the line to sink and moor it. On the 24th August, H. M. S. "Widgeon," Capt. Bullock, R.N., laid down two flag buoys between Dover and Grisnez to mark the line. On the 25th the tug went out of harbour and anchored off the Admiralty pier, which had not long been begun. A piece of the wire covered with lead to protect it had been led down the pier, and a joint was made between this and the end of the wire on the reel. This joint was made in a boat, Mr. W. Reid, senior, the well-known old telegraph contractor, being in the boat, and taking the soldering iron out of the jointer's hand, completing the joint himself.

On board the tug was Mr. Jacob Brett, the *concessionaire*, Mr. Wollaston, in engineering charge, Lieut. E. Burstal, R.N. from H.M.S. "Widgeon" with some of the "Widgeon's" men, Mr. Crampton, who was a visitor, the author of this article, and several other visitors. Some of the "Widgeon's" men were stationed aft with some net canvas in their hands, and held on to the line to check it a little. Some difficulty was experienced at first in putting on the lead weights. Eventually the tug's hawser-bridge was shipped and a workman placed astride on it hammer in hand. When it was time to attach a weight, the ship was nearly stopped and a lot of slack gathered by the men abaft the hawser bridge. One of the weights with rivets on was placed on the bridge ready, the line was then stopped, and a piece of soft hot gutta percha placed round the wire, and this was placed on the groove of the lower weight; the other weight was then placed on so that the two rivets in the lower weight came through the holes in the top one, and two blows with the hammer married them together. During this time the slack gathered aft was being payed out, and when this was exhausted the weight was handed over the taffrail, and paying out was resumed. On arriving at Grisnez we anchored. The end of the line was connected to the speaking instrument, a type printer (I think Brett and Little's—this Brett being no relation to Jacob Brett, the *concessionaire*).

The first signals printed off nonsense, and Mr. J. Brett seized on the slip and tore it up, which incensed us all, and Mr. Wollaston in particular, as it was a record of the *first signals sent under the Straits of Dover*. A piece was preserved by me which was afterwards given to the old Duke of Wellington, then staying at Walmer Castle. I left the tug then to rejoin the "Widgeon," but the end was soon after joined to the lead-covered shore ends laid from Cape Grisnez, and signals were exchanged from shore to shore, thus saving the concession. The next day the line was hooked up by a French fisherman on the French coast, and was cut through by him with his knife. Mr. Reid and his son assisted Mr. Wollaston in all this work, which was successful, and saved the concession and proved the practicability.

1851. The Dover and Sandgate cable (commonly called the Dover and Calais cable) was laid this year. This was the first real submarine cable. It has four conductors of No. 16 copper wire, covered with gutta percha to No. 2 B.W. gauge, sewed and wormed with tarred Russian hemp, and covered with ten No. 1 galvanised iron wires. The Gutta Percha Company supplied the wire, and the sewing and closing was done at the works of Messrs. Wilkins and Weatherby, at Millwall. Mr. Newall, who with Mr. Keeper held the patent for untwisted wire rope, served an injunction on Messrs. Wilkins and Weatherby, and the work was completed by Mr. Newall's staff. Mr. Wollaston and Mr. W. Reid were the engineers for this line, and Mr. Crampton was the contractor. The Admiralty lent the "Blazer" (an old paddle-wheel steamer), with her engines and boiler removed, to the contractor for the purpose of laying the cable, which was coiled into her. No break, except a rough kind of nipper, was fitted. The ship was towed to Dover, and on Sept. 25, 1851, the end was landed at the South Foreland, and the ship towed away seawards. She was not kept properly headed to the tide for her slow speed, and thus went considerably out of the proper line over the ground. Captain F. Bullock was attending on the expedition in H.M.S. "Widgeon" to direct the course, but the master of the tug for a considerable time would not keep the ship sufficiently headed to the tide, and thus she made a very bad course over the ground. Moreover, the "Blazer" broke her towing hawsers, and whilst new ones were being laid out she drifted helplessly with the tide, paying out the cable, and tailing it round at right angles to the proper line. Thus 24 miles of cable only reached to within half a mile of the shore. Some days after the half mile was spliced on, and the work completed.

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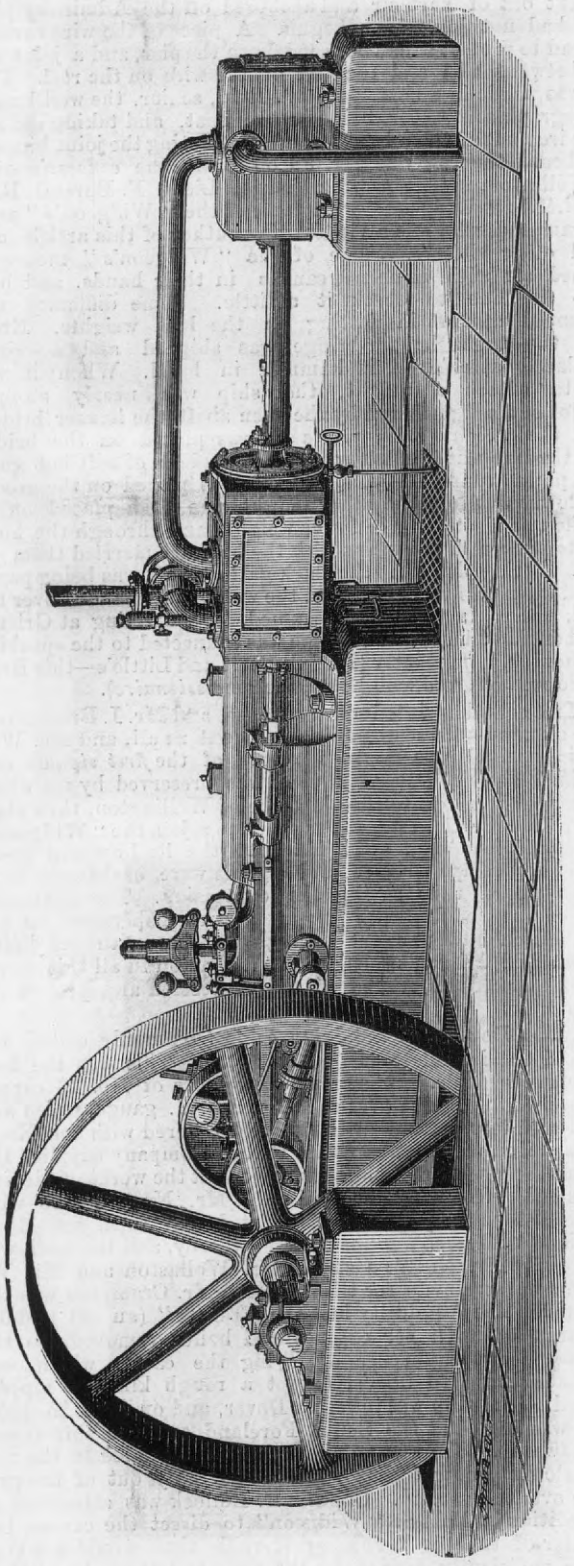
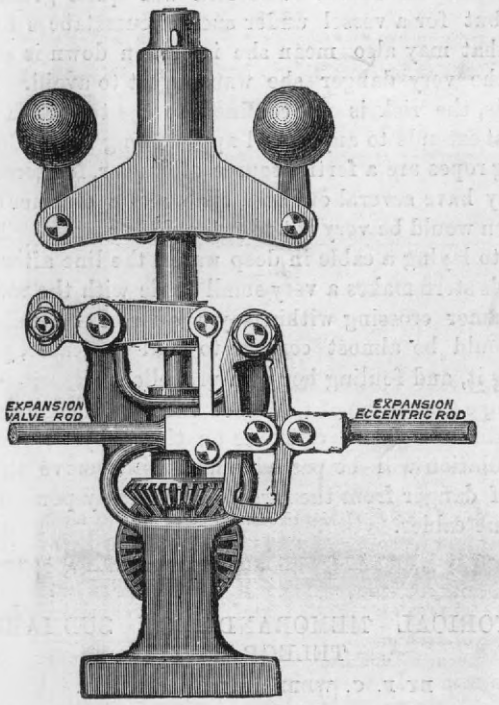
THE ELECTRIC LIGHT AT THE ROYAL ALBERT DOCK.

The London and St. Katharine Docks Company, finding the Victoria Docks too small for their requirements, obtained an Act of Parliament for extension in 1875, and Mr. Rendel, M.I.C.E., the consulting engineer of the company, was called upon to furnish designs. These plans have been at an enormous expense carried out, and recently the new docks were opened. As a



TYPE OF ENGINE BY MARSHALL, SONS, AND CO.

description says, we have now "in place of a desolate marsh, intersected by dykes, tenanted only by browsing herds, a magnificent dock, a mile and a half long, 490ft. wide, and some 30 feet in depth, provided with every appliance of modern engineering." At the commencement of the present, year the London and St. Katharine Docks Company invited tenders for the lighting by electricity of these new docks, named by them the Royal Albert Dock. A contract was made with Messrs. Siemens, and their system has been applied. The work was finished last Monday, when the directors officially inspected the lighting. A number of gentlemen were invited to accompany the directors on their tour of inspection. The visitors left the Great Eastern Station at Liverpool-street at 8:45 by a special train, which took them directly to the docks. On arrival, the company proceeded to a shed on the north side of the dock, which is lighted in the interior by a number of smaller lights than those used for the external illumination. It happened that a large vessel belonging to the Orient line had somewhat unexpectedly arrived, and men were busy in sorting and taking away the passengers' luggage. The work proceeded without any difficulty as regards light, for the shed was thoroughly illumined. Outside the entrance to the Docks, the quays and railroads are lighted by 27 powerful lights, placed on latticed iron poles, about 80 feet above the ground level, the lamps having been distributed in such a manner as to secure the best illumination at the dock-gates and swing-bridges, and to afford sufficient light generally for the proper carrying on of the traffic. Unfortunately the night was foggy, but with this disadvantage it was evident that work could be carried on almost as well by night as by day. We noticed particularly that the light through the glass roofs of the sheds was sufficient to enable goods to be stacked or taken out without difficulty. The electricity is produced at four stations, at each of which is fixed a 20 horse-power (nominal) steam engine and boiler, manufactured by Marshall, Sons, and Co., of Gainsborough. These engines are of the



horizontal type, and fitted with patent automatic expansion gear. This consists of a highly sensitive and powerful governor, shown above, of novel construction, acting through a link and die on to an expansion cut-off valve working at the back of the main-slide valve; the ordinary throttle valve is dispensed with, and the speed of the engine thoroughly controlled by means of the expansion valve, which regulates the admission of steam into the cylinder exactly in proportion to the duty performed by the engine. This gear is simple and reliable in its action, automatically regulating the speed with varying loads, and is thoroughly adapted either for heavy or light work. Engines equipped with this governor (the patentees say) develop more power, with greater economy in fuel, than if fitted with throttle valves in the usual way. Each station is fitted with the necessary Siemens machines—some of direct current, and some of alternate current type. The stations are arranged with a view to the further extension of the light, space and power being reserved for supplying a total number of twenty-four lights from each station. The stations contain also the necessary commutators and various appliances for measuring currents, &c. The leading wires from the stations to the lights are partly carried on telegraph poles, and partly conveyed underground, in the form of cables. The distance between lamp and generator varies from 120 to 1,100 yards, and the thickness of the wires has been chosen with a view to compensate as much as possible for this difference, and so equalise the intensity of the lights. The regulators are enclosed in lanterns, expressly designed to

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protect them against the weather, and they take carbons of sufficient length to last sixteen hours. The visitors were taken to one of the stations, and, so far as could be gathered from a cursory inspection, everything worked admirably. There is no doubt great care has been given and great attention paid to make the light effective, and we think the result will prove the wisdom of the directors in introducing the electric light on so large a scale.

DIAGRAMS ILLUSTRATING PAPER ON PHOTOPHONE BY ALEXANDER GRAHAM BELL.*

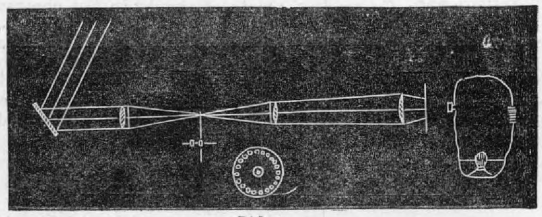

FIG. 1

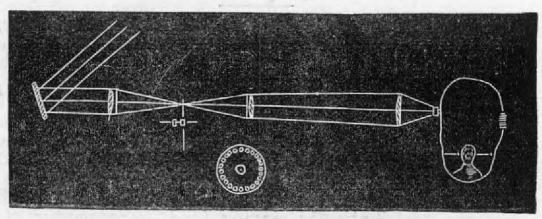

FIG. 2

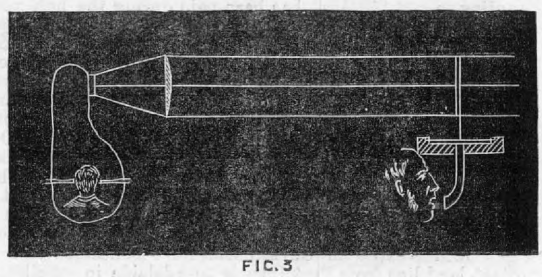

FIG. 3

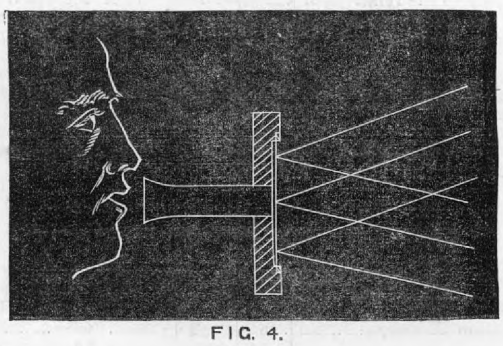

FIG. 4.

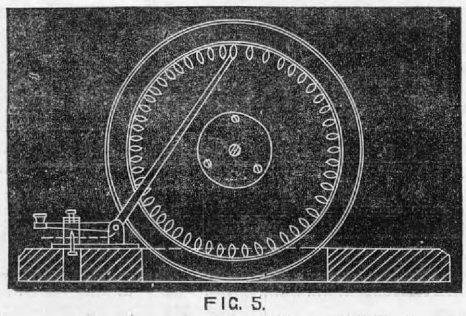

FIG. 5.

1. The interposition of hard rubber plate.
2. The light passed through openings in rapidly-revolving diaphragm, and reflected in selenious recesses.
3. Application of Fig. 4.
4. Action of voice on thin plate of silvered mica.
5. Application of Morse system of telegraphy to photophone.
6. Listening directly to receiving plate.

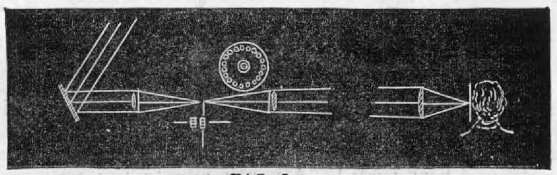

FIG. 6.

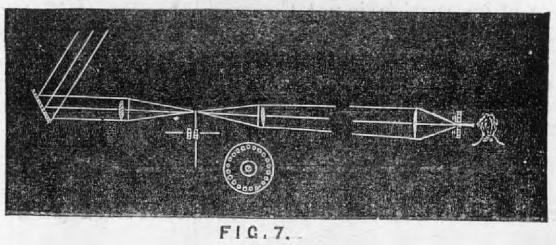

FIG. 7.

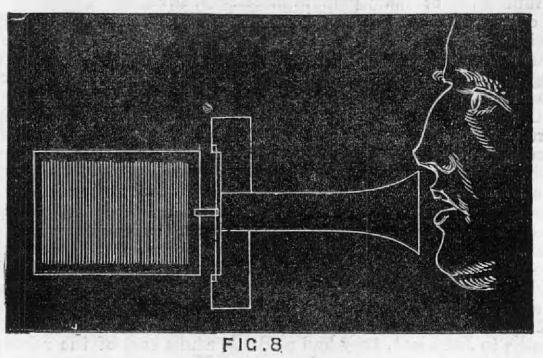

FIG. 8

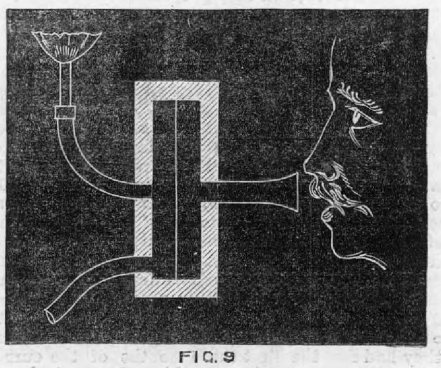

FIG. 9

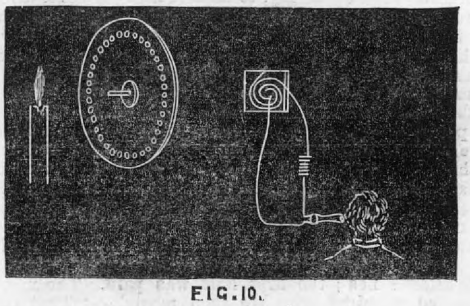

FIG. 10.

7. Another form of receiver.
8. One of the first forms; voice passed through slits.
9. Direct action of voice on gas flame.
10. Action of candle light on selenious recesses.

[* The diagrams illustrating Professor Graham Bell's paper did not reach us sufficiently early to give them with the paper. With these illustrations readers will at a glance see the simplicity of Professor Bell's work.—ED. *E.*]

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CORRESPONDENCE.

EMPLOYMENT OF WOMEN IN TELEGRAPHY.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Your article on the employment of female clerks for the telegraph service omits to mention one objection which I think is a serious one both as regards expense and efficiency. A certain time is necessary—and, of course, expense and trouble—to instruct a person, male or female (probably the same in both cases), before they are competent to take charge of a circuit or even send a message. Every year gives experience, and the more experience gives the more confidence to a clerk, who will avoid those errors which inexperience must conduce to, and do smarter working. A female adopts this employment as a means of livelihood until she gets married, and then leaves it, probably, when she is quite competent and very useful. A youth adopts the profession for life, so that he becomes experienced and useful for years, and the expense of instruction is not thrown away after a short time of usefulness.—Yours, &c., AN OLD TELEGRAPHIST.

ANSWER TO CORRESPONDENTS.—We have to acknowledge with thanks the receipt of the letters over the initials F. B. and G. A., and also those from R. V. and E. T.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).

The fourteenth ordinary general meeting of the above Company was held at the offices, 106, Cannon-street, on the 30th ult., under the presidency of Mr. Neil Bannatyne.

Mr. CHARLES GERHARDI, the manager, read the notice convening the meeting, and the report, which appeared in *The Electrician* of last week, was taken as read.

The CHAIRMAN, in moving its adoption, said that when they last had the pleasure of meeting them they were, as many of the shareholders who were then present might remember, in a position of some degree of uncertainty as to what would be the actual cost of the reinstatement of the cable. Any shareholder who was not then present would see that from the report and accounts for the half year ending the 31st December last, they had at the credit of the reserve fund £2,200, and also a balance at the credit of profit and loss on the working of those six months of £4,450. They had, then, to meet the whole of the cost of the expedition engaged in repairing the cable; and at that time they thought that that might possibly not only sweep away that sum, but also encroach considerably on their reserve fund of £2,200. As they would perceive from the report now presented for the six months to June last, they had paid the whole cost of the reinstatement of the cable between Bilbao and the Lizard, amounting to £5,209, taking from the reserve fund £759, and they proposed to pay a six months dividend at the rate of 10 per cent. per annum on the 10 per cent. preference shares. That left them a balance of £638, which they proposed to add to the reserve fund. They would see from that that they paid 10 per cent. for the six months on the preference shares, they wiped off the whole cost of the reinstatement of the cable, and they only diminished the reserve fund by the difference between £759 and £638, so that their reserve fund now stood at £2,078. He thought that was a great improvement on the position in which they stood when they last met. Their cables were in excellent condition and in full working order. No doubt they had six months arrears to pay on the preference shares, which was 10s. per share, amounting to something under £3,000, but he was glad to be able to inform them that their traffic since the beginning of this half year had been going on very satisfactorily. Their receipts for July showed an increase of about £500 over those of July, 1879; in August there was an increase of about £200 on August, 1879, and he believed, as nearly as they could anticipate, which was almost a certainty, that their receipts for this month would be nearly £400 in excess of those of September, 1879. It was always dangerous to prophesy, but if they could go on for the remaining three months as they had for the first three months of the current half year, they would be in the position, nothing happening, no breaks or anything of that kind occurring, to declare a 10 per cent. dividend for the half year and wipe out the arrears of the other half year, and then have something to the good. As, however, he had said before, any shareholder could tell how they were going on, and what was likely to be the result of the half year, because their normal expenses were £4,000 a-year—£2,000 every six months. The preference dividend required £3,000 for the half year, so that they required £5,000 each half year to meet what he might call preferential charges. Then what they might make over went to the reserve and the ordinary shareholders. He did not think he had anything further to state, but should be glad to hear any remarks and give any explanation that might be required. He then moved the adoption of the report and accounts.

Mr. ETLINGER seconded the motion.

Mr. DELEVINGNE: It is only the dividend for the last half of 1879 that is in arrear.

The CHAIRMAN: Yes; the first half was paid. The motion was then put and carried unanimously. He then moved:—"That 10s. per share, less income-tax, on the accumulated dividends on the preference shares be paid when the next remittance from the Spanish Government is received." They would understand that they could not pay the dividend till the money had been received from the Spanish Government, who were not obliged to remit it for three months. That Government had, however, been very punctual in their payments.

Mr. SHAW asked whether there were any reasons for the Spanish Government delaying remitting the money; it was not for a subsidy?

The CHAIRMAN replied in the negative, and added that the time allowed was only in accordance with the conditions of the Telegraph International Administration. The money referred to was what the Spanish Government collected for them, and, as he had said, they had always paid it with the utmost punctuality. They could not ask for the money till it was obligatory for it to be paid.

Mr. GERHARDI said they need not settle for six months, but they had always done so before that time.

The CHAIRMAN stated that they had always been considerably within the time. There was no doubt that they would have been in a position to pay the dividend, independently of the remittance, if it had not been for the outlay on account of the break of the cable.—The motion was then carried unanimously.

On the motion of Mr. COCHRANE, a vote of thanks to the chairman and directors was passed.

The CHAIRMAN, in reply, on behalf of his colleagues and himself, assured them that they did their best to promote the prosperity of the company. He thought they had now got into a position when they could look for a fair share of prosperity in the future. If they could only keep clear of breaks they were in a satisfactory position, as the traffic promised to be better than it had ever been.

The proceedings then terminated.

THE EASTERN EXTENSION AUSTRALASIA AND CHINA TELEGRAPH COMPANY (LIMITED).

Report of the directors for the six months ended 30th June, 1880, to be presented at the fourteenth ordinary general meeting of the company, to be held at the City Terminus Hotel, Cannon-street, on Wednesday, the 6th day of October, 1880, at 2 o'clock.

The directors submit herewith the usual statements of account for the half year ended 30th June, 1880. The gross receipts for that period have amounted to £173,020 0s. 11d., against £150,107 11s. 5d. for the corresponding half year of 1879, showing an increase of £22,912 9s. 6d. The working and other expenses (including a sum of £17,703 7s. 2d. for cost of repairs and renewals of cables and expenses of ships), together with interest on debentures, contribution to sinking fund for redemption of debentures, and income tax, absorb £77,484 10s. 6d., leaving £95,535 10s. 5d. as the net profit of the half year. One quarterly interim dividend of 1¼ per cent., amounting to £24,968 15s., has been paid during the half year, and it is now proposed to distribute another of like amount, together with a bonus of one shilling per share, payable on the 15th October, leaving a balance of £35,610 10s. 5d. to be carried forward. The cable between Hong Kong and the Island of Luzon (Manila) was successfully laid by the Telegraph Construction and Maintenance Company, and opened for traffic on 8th May last. In pursuance of the powers conferred by special resolution of the general meeting, held on the 22nd October, 1879, authorising the raising of capital for the purpose of laying this cable, the directors have issued £100,000 in 5 per cent. debentures, which have all been subscribed by the shareholders. The balance of the contract money (£20,000) will be taken from the reserve fund. The Company's cables have worked well during the half year, and are now in good electrical condition. The South Australian Government have continued to maintain their important land line from Port Darwin to Adelaide in excellent working order. The directors having from time to time received applications for assistance to the relatives of deceased members of the staff, have considered it desirable to establish an assurance fund on the same principle as that recently sanctioned by the shareholders of the Atlantic, the Eastern and other Telegraph Companies, the object being to enable the staff to secure the payment of a limited sum to themselves at a fixed age or to their families in case of their death, the Company paying one half of the requisite premiums. It is estimated that, if this plan is availed of by the *employés* generally, the cost to the Company would be about £1,500 per annum. A resolution empowering the directors to carry out the above arrangement will be submitted to the meeting.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES SEPT. 29.		BUSINESS DONE WEEK ENDING SEPT. 29. Highest.	Lowest.
Anglo-American Ordinary	64½,	¾	65¼	64⅛
Do. "B"	95½,	96	96⅜	95
Do. "A"	35⅝,	⅝	36½	35
Brazilian	9 7-16,	9-16	9⅜	9⅜
Cuba	9½,	¾	9½	9½
Do. Ten per Cent. Pref.	16¼,	¾	16¼	16¼
Direct Spanish	1⅞,	2⅛	2	1⅞
Do. Ten per Cent. Preference	11¾,	12⅛	12⅛	12
Direct United States	12⅝,	⅜	12⅞	12⅜
Eastern	9⅜,	⅞	10	9⅜
Do. Six per Cent. Debenture	106,	109	107½	106
Do. Five per Ct. do. 1899	103,	106	105	104½
Do. Six p Ct. Pref.	12½,	⅝	12⅝	12½
Eastern Extension	10 1-16,	3-16	10¼	10
Do. Six per Ct. Deb	108,	110	—	—
German Union	9¼,	¾	9⅜	9⅜
Globe Telegraph & Trust	6⅜,	⅝	6⅞	6½
Do. Six p Ct. Preference	12⅛,	¼	12¼	12
Great Northern	9⅝,	10⅛	10⅛	9⅝
Indo-European	25,	26	25¾	25½
Mediterranean Extension	2⅜,	3½	3	2⅝
Do. Eight p Cent. Pref	10⅜,	11½	10¾	10¾
Reuter's	10,	11	—	—
Submarine	243,	248	245	243½
West India and Panama	1¼,	⅜	1 7-16	1 3-16
Do. Six per Cent. 1st Preference	6⅜,	7⅛	7⅛	6⅜
Western and Brazilian	7½	⅜	7 9-16	7 5-16
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	101,	103	102	102

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	——	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	North Sea.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	St. Pierre.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	——	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

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Ages at Entry.	NUMBER OF PREMIUMS PAID. Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	——	——	787 10 0	517 0 0	310 10 0	137 10 0

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SLIP

PERSONAL.—Mr. G. Sealy, assistant-superintendent Persian Gulf Telegraph, is promoted to superintendent from July 18, 1879.

ZANZIBAR.—We understand the Eastern and South African Company have a workshop on board their hulk "Indus" at Zanzibar, where they undertake repairs to machinery, &c.

SALFORD.—The Salford Town Council are considering the propriety of promoting a bill in Parliament during the next session which, among other things, will provide for powers to supply electric light.

THE MORSE ELECTRO-MAGNET.—The magnet of a Morse instrument of ordinary construction attracts its armature when a current of 10 milliwebers, or, what is the same thing, 10,000 microwebers, traverses its coils.

THE TELEPHONE IN USE.—Messrs. Stevenson, Jacques, and Co. have placed their ironstone mines at Boosbeck, near Guisborough, in telephonic communication with their offices at Middlesborough and with their smelting furnaces at Acklam, the mines and furnaces being 15 miles apart.

PRICES.—Genuine gutta percha is quoted at from 6d. to 2s. per lb., reboiled from 3d. to 1s. India rubber is quoted per lb., Para (fine) 3s. 2d., Negrohead 2s. 3d., Central American 1s. 9d. to 2s. 3d.; Assam and Pegu 9d. to 2s., other East Indian 1s. 4d. to 2s., and Madagascar and Mozambique 1s. 7d. to 2s. 3d.

THE TELEPHONE IN SYDNEY.—The rooms of Mr. Cracknell, the superintendent of telegraphs, at the General Post Office, are fitted up with one of Edison's telephones. The communication is between the Post Office and the Exchange, and is said to work admirably. Attempts are being made to establish an exchange.

CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED.)—The number of messages passing over the lines of this company during the month of September was 1,725, estimated to produce £1,800, against 2,579 messages, producing £3,314 in the corresponding month of last year. The traffic receipts for the month of July, estimated at £2,800, realised £2,915.

JAMIN'S ELECTRIC LIGHT.—We understand that instructions have been given to proceed with the lighting up of the Royal Panorama, Leicester-square, and adjuncts with thirty Jamin's electric lights. The directors and artists of the Panorama have carried out some extensive trials at the works in Paris, and were so satisfied that they have decided upon adopting this system.

ROYAL EXCHANGE RESTAURANT.—It is difficult to introduce a grain of common sense into a brainless animal. It seems, however, certain that some such a creature has been "having some fun," as he would term it, with the electric light apparatus in use beneath the Royal Exchange. Fortunately the tampering was discovered in time to prevent serious injury, although not in time to prevent considerable temporary inconvenience.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).—The accounts to 30th June last show a balance to the credit of revenue account, including the balance from last half year, of £15,841, but in consequence of the interrupted condition of the company's system the directors have placed the sum of £10,000 to reserve account, and will recommend at the approaching meeting that the balance of £5,841 be carried forward to the current half year's accounts.

THE UNITED STATES.—The city council of Akron, O., has unanimously adopted the report of its select committee in favour of electric light, and has empowered them to proceed with the work. The total estimated cost is as follows:—Two boilers, 16ft. by 40 inches, 1,906 dollars; engine, 1,050 dollars; brick engine house and boiler foundation, 500 dollars; iron mast at "Hall's corner" (160ft.), 656 dollars; wooden mast at Buchtel College, 50 dollars; plate for mast foundation, 100 dollars; electrical machine, 3,438 dollars; total, 7,700 dollars.

THE MARSEILLE-BONA CABLE.—*L'Electricité* observes that, although the new cable between France and Algeria is termed "the third cable," there are already three cables, in tolerably good condition, uniting these countries. Of these two, between Marseille and Algiers, belong to France; the first cable laid, that between Marseille and Bona, belongs to England, and is exclusively reserved for the transmission of despatches between Great Britain and Malta, Egypt, or India. Originally, this cable was used only for messages between France and Algeria.

THE THIRD MARSEILLE-ALGIERS CABLE.—It appears that this cable has been laid between the two others; and *l'Electricité* urges that this position is an inconvenient one, and likely to lead to accident. On the occasion of the laying of the second cable, the buoyed end became detached; and, in dragging for it, the first cable was caught and broken, so that for some days the communication with Algeria was entirely interrupted. It was then found that the first cable had been shifted several miles by the action of currents; and our *confrère* apprehends that similar complications may arise in future.

RAPID TELEGRAPHY FROM AUSTRALIA TO LONDON.—On the 1st inst. a message of sixty-nine words was forwarded by the Governor of Victoria announcing the opening of the Melbourne Exhibition on that day. This message was despatched from Melbourne at 1 p.m., and reached London at 3:43 a.m. on the same day, or 9 hours 17 minutes before the hour of its despatch. Allowing, however, for the difference of time between the two cities, it occupied only twenty-three minutes in transit. The route of the message was over the lines of the Victorian and South Australian Colonies, the cables of the Eastern Extension, Australasia, and China Telegraph Company, the lines of the Indian Government, the cables of the Eastern Telegraph Company, and the lines of the Egyptian and French Governments, and the rapidity of its transmission shows the harmony with which these various administrations work together. The total distance traversed was 13,398 miles.

CHICAGO.—The Chicago Electrical Society was to open its winter season on Monday evening, Oct. 4, in the parlours of the Grand Pacific Hotel, on which occasion the paper was by Professor Elisha Gray, entitled "Conservation of Energy." This meeting is to be followed by others during the winter season of equal interest. Among the distinguished electricians who have promised papers are Mr. W. H. Preece, chief electrician of the English postal telegraph, and President of the Society of Telegraph Engineers; Professor Carhart of Evanston will lecture and illustrate Professor Cooke's discovery of the fourth ultra gaseous matter; Professor C. H. Haskins, of Milwaukee, on the subject of "Colour;" Dr. Tooker on "Electricity as the Vital Principle of Life;" Professor E. R. Page, on the "Future and Possibilities of Electricity," C. H. Wilson, and others. The society is about to open the season under very favourable auspices, and will probably add to this programme.

PHILADELPHIA.—Mr. W. J. Phillips, superintendent of the police and fire alarm telegraph, of Philadelphia, says

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that the present system is twenty-five years old, and the majority of the lines are almost worthless, needing constant repairing and great battery power to keep them up to their work; that they might be patched up and even extended, but their usefulness would be short-lived and the expenditure of money for that purpose injudicious. In one section, comprising the First, Second, Third, Fourth, Fifth, Seventh, Eighth, Ninth, Twenty-sixth, and Thirtieth wards, there are forty-four boxes, but there should be seventy in addition, or one hundred and fourteen in all. In another section seventy-five more boxes are needed. Mr. Phillips estimates the total cost of improving and extending the system at 81,300 dollars, of which amount 45,300 dollars is required for new boxes and repairs, 24,000 dollars for work and material, and 12,000 dollars for refitting the Central Station.

Telegrams to Regiments on Service.—The following letter on this subject appeared recently in *The Times*:—A short time ago I had occasion to send a telegram from England to an officer of my regiment then quartered in a station in the north of India. I knew that my regiment had been ordered to leave at once for the front and that they might leave their station before my message reached them; I therefore requested the clerk in the telegraph office to have the telegram sent on after them, either by telegraph or post, if they had marched before its delivery, and I told him that I would pay any extra charge incurred in doing so. He replied that he could not make any such arrangement, and that he did not even know whether the telegram would be sent after them at all or not. I may add that the charge was over £2 for the message, which consisted of only three words—each word of both the sender's and addressee's name being charged for at the full rate of 4s. 9d. a word.

Electric Storms.—The valley of the Missouri and other districts which suffered so much from tornadoes have been examined by Professor Tice, who has come to the opinion that the storms were of an electric nature. He arrived at this conclusion by the fact that the buildings which suffered most were those which were covered with zinc or other metallic roofing, while houses roofed with slate or tiles almost invariably escaped. The iron chimney of a factory was torn off and twisted about in a remarkable manner, while the rest of the building showed no trace of damage; and the same happened to the bell cupola of a large school, which, being made of sheet tin, was completely destroyed. The professor also noticed that those trees which suffered from the storm were not injured particularly from the windward side, or bent in any direction by the storm, but that the whole of them were stripped of their leaves instantaneously, and that the bark presented an appearance as of scorching.

The Electric Telegraph and the Fisheries.—During the last 20 years or so the Norwegian herring fishery has been greatly developed, a result chiefly brought about by the utilisation of the electric telegraph. During the greater part of the year about 40,000 fishermen are employed in the numerous fiords which deeply indent the coast between Drontheim and nearly to the North Cape, and thus well within the Arctic Circle. There are more than twelve hundred miles of wire employed; and at whatever station the shoals are seen approaching information of the fact is transmitted to all the others within reach, so that the piscatorial forces may be best directed on the finny prey. The fish-merchants are by the same means called to the, for the time, cheapest market. In the tunny fisheries in the Mediterranean, and in those of the pilchard on our own south-western coasts, watches are set upon the shoals, and the boatmen with their nets directed to the most productive spots of their harvest-field by comrades stationed on the cliffs; but this expedient of the Norwegian fishermen, for which they deserve every credit, is the first application to the same end of the more scientific appliance.—*Iron.*

The British Museum.—The British Museum has been closed during the past week, and was reopened yesterday. The usual period for such closing in former years for the purpose of cleansing was the first week in September. The alteration this year has been in order to adapt the time most suitable for the new process to be brought into operation for lighting the Museum with the electric light. For some time past the authorities have been preparing new machinery for the electric light, and powerful engines have been purchased and erected preparatory to the new experiments. During the interval while the Museum has been closed the electric light was better adapted for the purposes of the reading room, an increased number of lamps being used, and the flicker which was considered objectionable will, it is said, be so reduced as not even to be noticeable. Other portions of the Museum are also to have the electric light introduced, so that during the winter months visitors will be admitted after dark. The reading room will remain open till seven o'clock in the evening.

On the Aurora and Zodiacal Light of May 2, 1877.—Abstracted from a paper by Mr. Henry C. Lewis, at the American Association for the Advancement of Science. "A simultaneous appearance of an aurora and the zodiacal light appeared on this evening, and a comparison between them is here given. The various changes of the aurora are given in detail. A remarkable feature was the formation of a bright streamer which maintained its position relative to the earth for nearly an hour. Meanwhile, the zodiacal cone, which was bright early in the evening, had moved past the streamer and passed below the horizon. The streamer had remained, like the great pointer, fixed to the earth, and marking its motion, while the heavens revolved past it. This fact was conclusive evidence of the terrestrial character of the aurora and of the cosmical character of the zodiacal light. Another fact leading to the same conclusion was the character of their spectra. That of the zodiacal light was continuous, and that of the aurora was a line-spectrum—the former is such as would be given by sunlight reflected from matter in space; the latter would be given by an electric discharge through a gas."

The Electric Light in Paris.—M. Charles Garnier loudly demands the introduction of electricity, so as to preserve from destruction the works of art with which he has decorated the Paris Grand Opera. To descend from the sublime to the comic—from the Grand Opera to the Palais Royal—this latter theatre has been entirely redecorated, and in so remarkable a manner that it merits a few words of notice. M. Bayard has been entrusted with the work, and has painted on the walls of the *foyer*, or crush room, a biographical history of the theatre. On one side we have groups representing all the ancient actors in their most celebrated parts—the Père Amant, Boutie, Dêjazet, Julles, Pernon, Nathalie, and Mars. To unite the past with the present there is an allegorical group of nymphs and satyrs, and then we find the portraits of all the celebrities who still convulsed the gay audiences—Brasseur, Hyacinthe, Ravel, Schneider, &c. But we are reminded that these new and elaborate decotions, which possess the double attraction of works of art and works of history, will be prematurely obliterated if they are exposed night after night to the blaze of innumerable gas-burners. The Gymnase Theatre has also been redecorated,

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and these facts and the intense heat must account for the revival of the old contest relating to the respective merits of gas and electric light.—*Builder*.

WORK AT A TELEGRAPH OFFICE.—Seventeen reporters were present at the banquet given in the Music Hall, Inverness, the other afternoon. These included representatives of the daily press from Edinburgh, Glasgow, and Aberdeen, and one from the Press Association, which has its headquarters in London. The Inverness Telegraph Office had a vast amount of work thrown upon it, but all the messages—amounting in the aggregate to over 80,000 words, or about forty newspaper columns—were despatched with great rapidity. The first part of the first message was handed in at 6:5 p.m., but the staff was not generally employed till about 8 p.m. The last part of the last message was handed in at 10:35 p.m. The work was disposed of by Wheatstone automatic apparatus, and the wires were extended to Dundee, Manchester, London, &c., so that all the messages were sent direct to their destination, with the exception of those for Bristol and Plymouth. Of the above Aberdeen got 12,000; Edinburgh, 17,000; Glasgow, 8,000; Dundee, 7,000; Manchester, nearly 3,000; London, 22,000; Bristol, about 3,000; Plymouth, 3,200; while over thirty other papers got short summaries. The manual labour—that of punching—was finished at 10:45 p.m.—ten minutes after the last "copy" was received—and the whole work was cleared off by twenty minutes past twelve o'clock. This, we may say, is only a specimen of what occurs at the nearest telegraph office after any entertainment or meeting of more than a local nature, and yet we seldom or never think of this work when we read a long speech in our "daily" paper.

ON THE THERMO-ELECTRIC ELECTRO-MOTIVE POWER OF Fe. AND Pt. IN VACUO.—Professor C. A. Young of Princetown, in a paper on this subject, at the American Association for the Advancement of Science, said that Eisner, a few months ago, published a paper, asserting that the thermo-electric power of antimony and bismuth is destroyed by removing them from all contact with oxygen, and inserting them in an atmosphere of pure nitrogen. From this he argues that the thermo-electric force in general is due to the contact of the gases which bathe the metals. The following experiment was tried to test the theory:—By the kindness of Mr. Edison and Mr. Upton a vacuum tube was prepared in Mr. Edison's laboratory, containing an iron wire, about 2 inches long, firmly joined to two platinum terminals which passed through the walls of the tube; the tube was exhausted until a 2-inch induction coil spark would not pass $\frac{1}{8}$ of an inch in the gauge-tube, indicating a residual atmosphere of about one-millionth. The wire was heated to incandescence during the exhaustion, in order to drive off any possible occluded gases. The platinum wires outside the tube were joined to iron wires, the joinings being covered by glass tubes slipped over them, and a sensitive reflecting galvanometer was included in the circuit. By laying the tube and connected joinings in the sunshine, and alternately shading one or several of the joinings, it was found that the electromotive power of the joinings within the tube was precisely the same as that of those without, and the development of current just as rapid. There was no trace of any modification due to the exhaustion.

ON THE ABSOLUTE INVISIBILITY OF ATOMS AND MOLECULES.—At the American Association for the Advancement of Science, Professor A. E. Dolbear said: Maxwell gives the diameter of an atom of hydrogen to be such that two millions of them in a row would measure a millimetre, but under ordinary physical conditions most atoms are combined with other atoms to form molecules, and such combinations are of all degrees of complexity; thus a molecule of water contains three atoms, a molecule of alum about one hundred, while a molecule of albumen, according to Mulder, contains nine hundred atoms, and there is no reason to suppose albumen to be the most complex of all molecular compounds When atoms are thus combined it is fair to assume that they are arranged in the three dimensions of space, and that the diameter of the molecule will be approximately as the cube root of the number of atoms it contains, so that a molecule of alum will be equal to

$$(\sqrt[3]{100} = \cdot 464)\ \frac{4 \cdot 64}{2000000} = \frac{1}{431000}\text{ mm.},$$

and a molecule containing a thousand atoms will have a diameter of $\frac{10}{2000000} = \frac{1}{200000}$ mm. Now, a good microscope will enable a skilled observer to identify an object so small as the $\frac{1}{4000}$ mm. Beale, in his works on the microscope, pictures some fungi as minute as that, and Nobert's test bands and the markings upon the *Amphiplura pelucida*, which are of about the same degree of fineness, are easily resolved by good lenses. If thus the efficiency of the microscope could be increased fifty times $\left(\frac{200000}{400} = 50\right)$ it would be sufficient to enable one to see a molecule of albumen, or if its power could be increased one hundred and seven times it would enable one to see a molecule of alum. Now, Helmholtz has pointed out the probability that interference will limit the visibility of small objects; but suppose that there should be no difficulty from that source, there are two other conditions which will absolutely prevent us from ever seeing the molecule. 1st. Their motions. A free gaseous molecule of hydrogen at the temperature of O°C., and a pressure of 760 mm. mercury, has a free path about $\frac{1}{10000}$ mm. in length, its velocity in this free path being 1,860 m. per second or more than a mile, while its direction of movement is changed millions of times per second. Inasmuch as only a glimpse of an object moving no faster than one millimeter per second can be had, for the movements are magnified as well as the object itself, it will be at once seen that a free gaseous molecule can never be seen, not even glimpsed. But suppose such a molecule could be caught and held in the field so it should have no free path. It still has a vibratory motion which constitutes its temperature. The vibratory movement is measured by the number of undulations it sets up in the ether per second, and will average five thousand millions of millions, a motion which would make the space occupied by the molecule visibly transparent—that is, it could not be seen. This is true for liquids and solids. Mr. D. N. Hodges finds the path of a molecule of water at its surface to be ·0000024 mm., and though it is still much less in a solid it must still be much too great for observation. 2d. They are transparent. The rays of the sun stream through the atmosphere, and the latter is not perceptibly heated by them as it would be if absorption took place in it. The air is heated by conduction—contact with the earth, which has absorbed and transformed the energy of the rays. When selective absorption takes place the number of rays absorbed is small when compared with the whole number presented, so that practically the separate molecules would be too transparent to be seen, though their magnitude and motions were not absolute hindrances. [We are indebted to our American contemporary *Science* for this and other abstracts of the work of the American Association.]

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 233.)

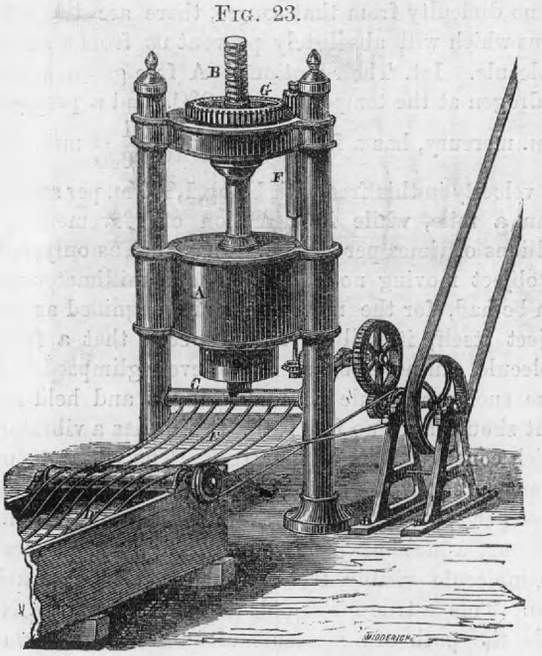
LECTURE IV.—DELIVERED FEBRUARY 23, 1880.

Special applications of Vulcanised India Rubber. Mechanical and Engineering Applications. Surgical Uses. India Rubber Stamps or Stereotypes. Vulcanised Caoutchouc in the Dwelling House, the Garden, Children's Play room, and the Printing office.

Few materials have received such numerous applications in the industrial arts as vulcanised caoutchouc; and, in many instances, the applications of india rubber are of considerable commercial importance. So various, indeed, are the uses to which this material is applied, that the mere reading of a list of its applications would occupy much more than the hour allotted for this lecture—as a rough estimate, I should say it would take just about two hours and three-quarters—so I will not do it, but will rather call your attention to a few matters which either are of special interest or happen to present themselves to me to-night.

A pad of india rubber has a remarkable effect in deadening vibration or recoil, and a slab or sheet about an inch thick is a useful thing to place underneath an anvil, in order to reduce the the noise arising from hammering thereon. Again, you know that railway-carriage buffers work against blocks of caoutchouc, these having a remarkable effect in reducing the destructive action arising from the jarring and striking of the carriages against each other. In the case of rubber intended for such purposes, there is, generally, no disadvantage in somewhat hardening the material, by admixture with either one of the inert powders already referred to as being suitable for lowering the quality of vulcanised rubber.

FIG. 23.



APPARATUS FOR MAKING THREADS BY THE PROCESS OF SQUIRTING.

Here, among the articles lent by the Silvertown Company, is an arrangement for lessening the recoil of an ordinary shoulder gun or rifle. It consists of a plate of ebonite, faced with soft rubber, and is intended to be attached to that part of the gun which is placed next to the shoulder.

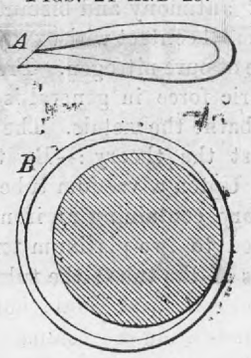
The production of threads of caoutchouc by the process of squirting, is one of considerable interest, and it can be illustrated to you in a very simple manner. Here is a metal apparatus very similar in size and appearance to a small pewter squirt, and I will fill it with caoutchouc which has been softened by means of a small proportion of benzole. The beak of the apparatus being placed in the focus of the lantern lens, you see that a magnified image is projected on the screen. The piston being now forced into the cylinder, the softened rubber is driven out in the form of a cord or thread, which really descends from the nozzle of the squirt; but owing to the inverting action of the lens, it appears to ascend on the screen. The threads thus formed must be exposed to the air, in order that all traces of benzole may evaporate, after which they may be cured in any of the usual ways.

The drawing now projected on the screen (Fig. 23) represents an arrangement for the production of threads by the process of squirting. A represents the main cylinder of the apparatus; while F is the rod attached to a piston which fits into this cylinder. The piston is forced down by the gearing represented towards the right of the figure, and in the lower part of the cylinder a series of fine-wire gauze strainers is fitted, in order to remove any solid impurities which may be present in the caoutchouc paste. The pressure of the piston next forces the india rubber into a horizontal tube, marked C, the lower part of which is perforated by a series of holes, out of which the material exudes, forming a row of threads, these being then led forward by an endless band of velvet, E. The threads next pass into a trough, D, which contains running water; whence they are afterwards carried by a long endless band of calico or linen, on which they become sufficiently dry to be wound on bobbins, a little French chalk being made use of to prevent adhesion.

Washers and circular valves are largely employed for many purposes, and these may be cut out of the mixed rubber sheet, or they may be moulded out of the mixed rubber. In either case they can be imbedded in French chalk during the process of curing by steam, or they may be cured in moulds, brass, tinned inside, being a very general material for these. The merest trace of oil on the surface of the mould prevents any adhesion to it during the curing process. It may be premised that it is generally necessary to support articles of mixed rubber during the process of curing by heat, as the material softens very considerably before the true curing action steps in. Sheets are generally supported by being wound on a drum together with a cloth, and are then cured in water, while many small articles may be conveniently cured in moulds made of baked clay or slate, these being cheaper and more easily made than metal moulds. It often happens that it is more convenient to cut small washers and discs from the vulcanised sheets, although this course naturally involves some waste of material.

The firms which were mentioned at the last lecture have placed at my disposal the extensive series of specimens illustrating the above-mentioned uses of india rubber, and you can examine these for yourself after the lecture.

FIGS. 24 AND 25.



The manufacture of the various kinds of tubing forms a very important part of the rubber industry. The usual manner of fabricating tubes is to cut the mixed rubber sheet in such a way that, when the edges are put together, no ridge shall be left projecting on the inside or outside of the tube, a matter which is very well illustrated by the diagrams which will be immediately projected on the screen (Figs. 24 and 25.)

A strip of the softened mixed rubber sheet being bent over on itself, the edges are cut off as at A. On now placing the fresh edges together, as represented at B, they fit together, forming a tube, and a loosely-fitting mandril being introduced, the joint is strengthened by being rolled longitudinally with a small roller, resembling a minature garden roller, made slightly hollow in the middle. The mandril is generally left in during the vulcanisation or curing of the tubes, the so-called "chalk cure" being adopted, as already explained. Very often the removal of the mandril presents some difficulty, and, in consequence of this, it is not unusual to employ a spiral wire instead of a solid metal mandril, this being left in the tube when sold. Machines have been constructed for the making of tubes, but with varying degress of success. In the case of tube machines, a flexible core, or kind of rope, is generally used as a mandril. Tubes are often built up of alter-

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nate layers of india rubber and canvas, this latter being saturated or filled in with softened rubber by means of the frictioning machine. The frictioning machine, one form of which is illustrated by the diagram now on the screen, somewhat resembles a calendar; indeed, it often happens that the calendar is fitted with gearing, to enable it to be used as a frictioning machine; and in passing between its rollers, the interstices of the canvas become so filled with the softened rubber, that the frictioned material can be worked in with the rubber when composite tubes are desired. In some cases a spiral wire is imbedded between two layers of india rubber, the tube thus obtained being well adapted for suction purposes. The variety of tubes thus built up out of rubber, wire, and textile materials is very great, and the samples and sections lent by the Silvertown Company, Messrs. Davis and Henwood, Tuck, and others will be reviewed by you with interest.

Another method of making tubes is by the squirting process already illustrated to you in the case of threads. In this instance, the mixed rubber, previously softened by heat, or by a solvent, is forced through a die, but this must be provided with a central core or mandril, to form the bore of the tube. Seamless tubes made in this way are very useful for laboratory and other purposes. On the table there are some interesting samples exhibited by Mr. Hancock.

The so-called insertion sheet, which is composed of alternate layers of rubber and frictioned canvas, is very useful in case great strength should be required. Sometimes wire gauze is inserted between rubber sheets in a similar manner.

India rubber steam packing is of very great value for making the stuffing boxes of engines steam tight. It is also employed for packing the shaft holes of vessels, and other similar purposes. The steam packing generally takes the form of a cord, built up of india rubber, frictioned canvas, and lubricated or stearined cotton. The extraordinary number of patterns or devices into which these materials are occasionally worked, is well illustrated by the sections which are exhibited by the Silvertown Company, and by Mr. Tuck. This gentleman has made an especial study of the manufacture of rubber packing, and you will be interested in studying his model, which illustrates the method of placing the packing into the stuffing boxes, &c. Generally, packing contains a small square core of rubber, and this is bound round with several layers of frictioned canvas. In such a case, the india rubber core gives the necessary spring or elasticity, while the frictioned canvas endures the hard wear; so tightness is secured in the stuffing box.

The use of gas bags, air pillows, beds, &c., formed of two thicknesses of cloth, separated by a layer of rubber, has now become very general, and one can only appreciate the ingenuity exercised in the manufacture of such articles by either seeing them put together or cutting one of them open, so as to expose the method adopted in building it up. Gas bags have been found very useful for carrying a supply of illuminating gas for the lighting of trains; but the use of them somewhat impoverishes the gas, as the caoutchouc absorbs several of those hydrocarbons which contribute largely towards its illuminating properties. As an insulating material for telegraph and other electrical wires, caoutchouc holds a very high place, and these specimens, kindly supplied by the Silvertown Company, and by Messrs. Rickards and Co., of Derby, will abundantly illustrate this use of india rubber, and the method of coating the wires.

Belting, for the transmission of power, can be very advantageously made of alternate layers of rubber and frictioned canvas, these being built up to the required thickness. Belting is generally cured by dry heat, and in the following manner:—An iron mould, something like a gutter, is provided, this being planed out to the exact width of the belting. Into this gutter-like mould, which may be about 20ft. long, a strip of iron fits accurately; so that a piece of belting introduced into the mould is enclosed everywhere excepting at the ends. One end of a length of made-up, but not cured, belting being introduced into the iron mould, the necessary heat for curing is applied by means of a massive steam press (Fig. 26), which consists of two rectangular cast-iron chests, heated internally be steam. Generally speaking, the chests are heated to a temperature as high as 150° Centigrade, in order that the vulcanisation may proceed quickly.

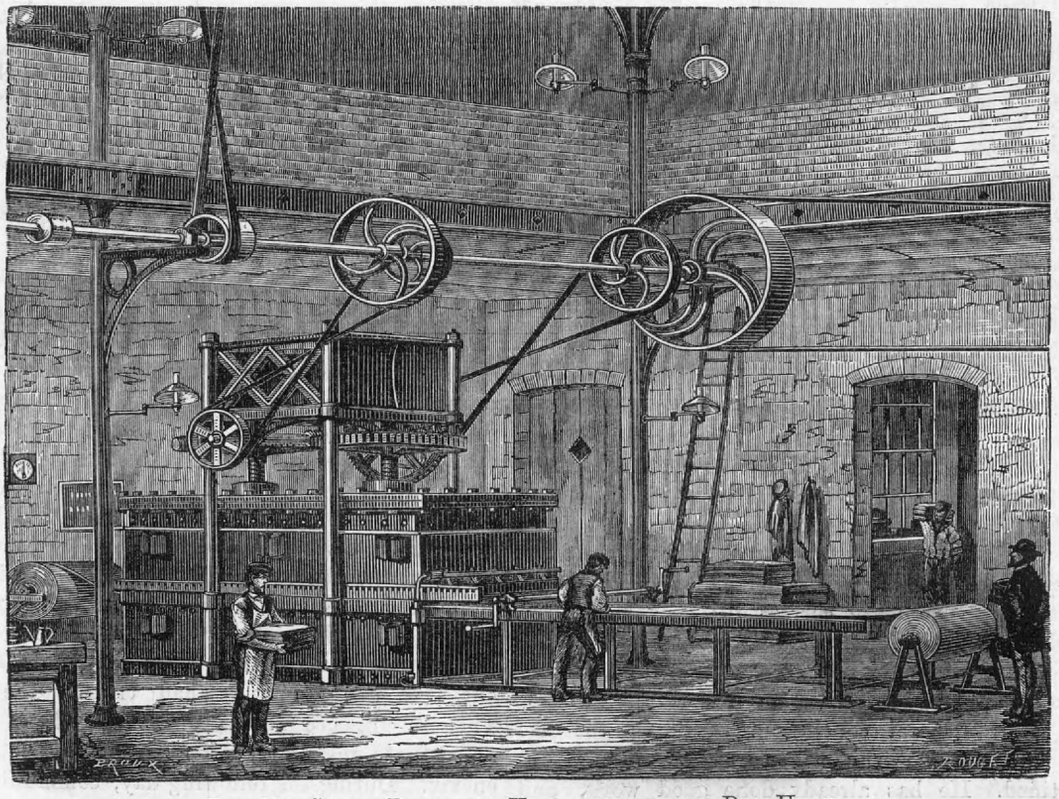

FIG. 26.—STEAM PRESS FOR VULCANISATION BY DRY HEAT.

In about 20 or 30 minutes, a fresh portion of the belting is exposed to heat in the mould, and so on until the whole length has been vulcanised. The method of vulcanising in question possesses the advantage of yielding belts with very accurately square edges, so that the whole width is available for the transmission of power. The steam press is excellently well adapted for the vulcanisation of figured or patterned sheets of caoutchouc, intended for ornamental purposes, and the engraving (Fig. 26) represents such a use being made of the apparatus. India rubber belting should, naturally, be protected as far as possible from the action of oil, as the continual motion and straining very much favours the destructive action of fatty matters upon it.

Caoutchouc has been largely employed in the manufacture of surgical appliances, several examples of such uses of caoutchouc being now before you. Elastic stockings, belts, and bandages are of considerable value, as they exercise a more continuous and equal strain than would be the case with ordinary bandages. Messrs. Cow and Co. have provided some samples of their extra-elastic bandages, made out of spread sheet—a form of rubber which will be considered in the course of the evening. Other appliances—such as infants' feeding gear, injection apparatus, pessaries, &c.—are represented in the collection before you, but they require no special explanation.

(TO BE CONTINUED)

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ARMY SIGNALLING.

Readers of Professor Tyndall's "Heat a Mode of Motion" will remember the emphasis given to the fact that light, heat, energy, &c., are almost entirely derived, directly or indirectly, from the sun. Professor Bell, in his interesting investigations in telephonic transmission, has shown us that we have not yet completely harnessed the sun, nor obtained from its rays all the services that they can render. It is dangerous as well as difficult to attempt to foretell, the applications to which a scientific discovery may be put, any short time after the discovery has been made public. We may also question whether statements made are correct till they have been corroborated by independent workers. Sometimes an investigator, desirous of achieving a certain result, seeing his experiments tend to confirm prior reasoning, rushes too soon to a general conclusion. Still, in the case of Professor Bell, we think such a surmise would not be justified. He has already done good work, and his results, as brought before the world, have practically remained unchanged. Bell's telephone, as a telephone, has resisted all attempts at infringement. It was, to all intents and purposes, as perfect when first publicly shown by the inventor as it is now. We may rest assured, then, that a scientific man of his ability would not launch any half-formed opinion, or set forth any conclusions that had not received clear and decisive experimental proof. One of the purposes for which Professor Bell's new discoveries can be employed seems to be in connection with military work. We have more than once drawn attention to "Telegraphy in Warfare," but it is possible that this latest phase of electrical development will enable, not only signalling, but conversation to be carried on; at any rate, across distances which, previous to this discovery, have prevented such communication. A very good knowledge of the existing state of army signalling may be obtained from various papers in the *Journal of the United Service Institution*, in a recent number of which appears Major Wynne's paper on "Heliography and Army Signalling Generally." In this paper it is stated that Mr. Mance in 1869 brought his heliograph to the notice of the Indian Government, who sanctioned its adoption in 1875, and that it was first used in India in 1877-8 during the Jowaki-Affridi Expedition. Major Wynne thinks the general opinion that sun-flashing was used for signals during the siege of Sebastopol is wrong, and that the Russians had no idea of such a method at that time. Naturally, one wonders that if the system was known why was it not used in the recent war with Turkey. The late Charles Babbage in 1851 invented an occulting telegraph, in which it is said the Duke of Wellington took great interest, and when the report of the signalling by means of sun-flashing by the Russians came home, the inventor wrote a letter to *The Times* suggesting the idea of adapting sunlight to his system. It has again and again been pointed out that wherever sound or light can penetrate signalling can be carried on. The Morse or any similar alphabet admits of the widest use. It is unnecessary to have long and short sounds, strong and weak will answer the same purpose, two different notes, the report of a small gun and a large one, any alteration, in fact, of the sound is sufficient to enable the code to be used. The accounts given of the use of heliography in the recent war in Afghanistan are very interesting. Major Wynne says: "Among the many merits of the heliograph, the ease and certainty of attracting attention must not be overlooked. Every inch of country visible can be gradually searched by its means, and the position of parties unknown before ascertained." As an example of this power he cites, among other instances, the capture of the Peiwar Kotal on the 2nd December, 1878, which was effected by two columns, one of which attacked in front the other in flank. The configuration of the country did not admit of direct heliographic communication between them, but it was practicable by the establishment of an intermediate station. The detached signalling party, however, failed to reach the pre-arranged point, but by flashing all over the hillside their actual position was discovered and interchange of messages effected. But perhaps the most striking instance of the immediate value of signalling was during Captain Straton's visit to Jellalabad last January. "On the 12th of that month, when at the signal station of Aliboghan, he found out that the Momunds had crossed the Cabul River. This intelligence he at once flashed off to Jellalabad, and that night a brigade started to intercept the enemy. During the following day, communication was successfully maintained between General Bright's head-quarters at Jellalabad, the brigade sent out, and a detachment of it, crowning the heights. At 1:15 p.m. (13th) Captain Straton saw about 1,500 men trying to cross the river at such a point that, if they had succeeded, the brigade would have been cut off from Jellalabad, and the detachment severed from its main body. But intimation was at once signalled to all concerned, and by 3 p.m. a couple of guns sent out from Jellalabad were shelling the enemy with such good effect that they beat a hasty retreat." In countries where the sun is a pretty constant visitor, the value of such a means of signalling cannot be overrated. Time after time in Afghanistan the telegraph wires were cut, and lengths carried away, and so for hours, and even days, no messages could by this means be sent, yet the heliograph flashed its intelligence, and kept up constant communication.

There are times, however, when the heliograph must fail, although the apparatus has been successfully worked by moonlight and by artificial light. It may be truly argued that wherever the heliographic system failed, Bell's photo-

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phonic system might fail also. We do not expect Bell's discovery to supersede Mance's invention, but we do hope to see in it an additional means of communication. Time is a factor of the utmost importance in war, and circumstances frequently arise when a few minutes' conversation between two leaders would be more valuable than any system of signalling. The saving of time would certainly be a strong recommendation in favour of the new system, if its application be practicable.

CORRESPONDENCE.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: The vast number of minds now employed in endeavouring to extend the use of electricity renders it very essential that those books which are published as guides to the students of electricity should contain accurate statements of the facts we already know about electricity. An admirable work on this subject has just appeared from the pen of J. E. H. Gordon, Esq., assistant secretary of the British Association. At page 8 he writes:—"The friction machine is essentially an apparatus for conveniently rubbing glass and silk together, and collecting the electricity produced. It is made in several forms. The glass plate machine consists of a circular plate of glass, which can be revolved on an axis by turning a handle. Two pairs of cushions covered with silk press against it near its edges. The cushions are connected with the ground so that the negative electricity produced on them can escape." This statement is erroneous and misleading. It implies that a current of electricity goes from the cushions to the ground when an ordinary plate-glass electrical machine is in motion. This is not true. It is one of several misstatements concerning the nature of electricity which for nearly two centuries have helped to conceal from men the true nature of electricity.

That you may have no hesitation in publishing my assertion that Mr. Gordon's statement is not true, and that he may be stimulated to approach this subject in a friendly spirit, I hereby offer to pay him the sum of fifty pounds if he will, by experiments, produce to me ocular proof that a current of electricity goes from the cushions to the ground when a common plate glass electrical machine is worked in the usual manner. On the other hand, I am prepared to show him by experiments—ocular proof—that, when the aforesaid machine is in motion, instead of a current of electricity going from the cushions to the ground, a current of electricity goes from the ground to the cushions, a fact which completely demolishes the popular theory of two electric fluids — a theory which during last century and the present has blinded men's minds against the true nature of electricity. All the heavenly bodies are immersed in a vast expanse of "free electricity." And imprisoned electricity fills the pores or spaces between the particles of all the solid and gaseous matter of this world.—Yours, &c,

JAMES JOHNSTONE.

Craiglockhart Hydropathic,
Near Edinburgh, September 30th, 1880.

ELECTROLYTIC "POLARISATION."

BY DESMOND G. FITZGERALD.

M. F. Exner has recently advanced, in relation to what is generally, although absurdly, termed "polarisation" in voltaic batteries, certain views which seem to show that the facts which constitute the electro-chemical basis of voltaic action are by no means universally admitted or understood. M. Exner holds that the distinction between "constant" and "inconstant" batteries is founded on a mistake, that all voltaic combinations are equally constant, and that no electromotive force is developed by the "contact of a metal with a gas."* When, in the case of a so-called "inconstant" couple, hydrogen becomes accumulated at the negative electrode, and the electromotive force is observed to diminish, this phenomenon cannot, according to his view, be ascribed to "polarisation," or to the production of an opposing electromotive force, and its cause must be sought in another direction.

I am under the impression that the existence, in a "polarised" cell, of what may correctly be termed an "opposing electromotive force" is a matter of experimental fact rather than of opinion; and the contention of M. Exner, as above stated, is at the best only a question of logomachy, or of the definition of terms. Still less happy, inasmuch as it is more diametrically opposed to verifiable fact, is the following statement in which the views of the same authority are further elucidated:—

"The development of an electromotive force in any hydro-electric element is solely the result of the chemical actions produced, and the magnitude of this force depends upon the heat developed. But if the compounds decomposed by chemical action become reconstituted afresh, the heat of recombination must be subtracted from that due to the original chemical action; and it is in this recomposition of the decomposed electrolyte that the true polarisation of the various cells is to be found."

Now it would be admitted by this authority (and in a qualified sense the admission is correct) that the electrolyte water is decomposed in the Grove or Bunsen cell, and also in that of Smee; and, if this be assumed, it is certain that in the former case the electrolyte is reconstituted by oxidation at the expense of the nitric acid, whilst in the case of the Smee cell the hydrogen is evolved. So that, according to the views of this writer (if they have been correctly reported), the heat due to the combination of hydrogen with oxygen must be subtracted from that due to the oxidation of zinc and to the solution of the oxide in sulphuric acid in order to find the electromotive force of the Grove or Bunsen cell; whilst that of the Smee cell is simply represented by the first-mentioned quantity of heat. In other words, the electromotive force of the Smee cell would be very considerably greater than that of the Grove or the Bunsen cell, and the evolution of an electro-positive, such as hydrogen, of high intrinsic energy would result in a great accession of force.

The suspicion that M. Exner may possibly have been incorrectly reported is strengthened rather than otherwise by the fact that another portion of the paper referring to his views is in glaring contradiction to the above, containing a curious blending of erroneous notions with glimpses of the electro-chemical law upon which the electromotive force of a voltaic couple is dependent. "In a Daniell cell, of which the electromotive force will be taken as unity, the oxidation of an equivalent of zinc developes heat to the extent of 24,300 calories*, and this heat is the measure of the electromotive force of the element. In another element, for example that of Smee, constituted by zinc, platinum and acidulated water, the chemical actions are somewhat different. The zinc combines with the oxygen of the water, and the oxide of zinc thus formed combines with the sulphuric acid. These two chemical actions develop 52,370 calories per equivalent of zinc. If, therefore, there were no other chemical action in the Smee element, the electromotive forces of the Daniell and Smee elements would be as 24,300 : 52,370, or as 1 : 2·15. But water is decomposed; and this decomposition represents a loss of heat of 34,570 (? 34,462) calories per equivalent; so that the effective loss of heat is only 17,800 calories. Consequently the true ratio between the Daniell and Smee elements is 24,300 : 17,800, or 1 : ·732. In experimenting with a Smee element, we do not at first starting find that this ratio obtains. Instead of being weaker, the Smee element is, at the commencement of its action, always stronger than the Daniell element; but it rapidly weakens, and, at the end of one or two minutes, its force is diminished to ·732. When it has reached this point, the force remains as constant as that of the Daniell element, even when the Smee cell is kept in action during several hours (provided the fluid retains its character). The true electromotive force of a Smee element is thus ·732 of a Daniell cell. What occurrs in the case of all the other elements termed inconstant may be explained in an analogous manner."

Now, special attention is here very necessarily directed to the fact that, in the case of the Smee cell, the electro-chemical action involves a decomposition as well as a combination. The combination is that of zinc with oxygen and sulphuric anhydride, *i.e.*, the zinc combines with the acid radical SO_4. The decomposition is stated to be that of water (H_2O); it is in reality that of H_2SO_4, the electro-chemical equation applicable to the Smee cell being simply:—

$$Zn + H_2SO_4 = ZnSO_4 + 2H.$$

But there is a precisely analogous decomposition occurring in the case of the Daniell cell; and this is not in any way adverted to. In this case, also, zinc enters into combination with the acid radical SO_4; but, in lieu of hydrogen, copper is set free; the equation in this case being:—

$$Zn + CuSO_4 = ZnSO_4 + Cu.$$

In every voltaic cell, without exception, the electro-chemical equation reveals the fact that an electro-positive of higher

* *Journal Télégraphique*, August 25th, 1880.

* The *oxidation* of the equivalent (32·7 grams) of zinc would evolve about 42,300 calories.

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intrinsic energy is *exchanged* for one of lower intrinsic energy. Practically it is zinc that is substituted, in combination with an acid radical, for hydrogen, copper, nitric oxide or peroxide of nitrogen, mercury, silver &c.

Now, what may be accepted as the fundamental law in relation to the production of electromotive force by voltaic means was stated by me ten years ago as follows :—"The electromotive force of a voltaic couple is proportionate to the difference between the calorific equivalents of the electro-positive bodies of which one replaces the other in combination within the voltaic cell."* It appears to me that the amount of truth that is involved in the views of M. Exner is dependent upon a vague and partial recognition of this law; whilst on the other hand the inaccuracies and errors are due to its imperfect realisation. The law in question is related to and harmonised with the facts of the contact theory of voltaic action (involving an augmentation of force by the employment, as the elements of a couple, of conductors further apart from each other on the electro-chemical scale) by the discovery, due to the labours of Daniell, that the negative element of a couple is virtually the *liberated* electro-positive constituent of the electrolyte decomposed by the passage of the current. If the liberated constituent be of the same nature as the original negative element of the couple, then the latter is constant—there is no "polarisation." If what is *primâ facie* the electro-positive component of the decomposed electrolyte be not actually evolved, if it enters afresh into combination, then, according to the nature of this combination, "polarisation" may be obviated or may, more or less slowly, grow to a maximum. In the latter case, the original negative element of the couple becomes "electro-plated" with, or receives a deposit of, the electro-positive component of the decomposed electrolyte. But, let us hear how M. Exner accounts for the fact that "polarisation" is not exhibited until this electro-deposition is completed, or to some extent advanced :—

"Now, how is it that the Smee element exhibits in the first place an electromotive force higher than that indicated by theory? M. Exner explains this phenomenon by the presence in the water of a certain quantity of free oxygen. The decomposition of water is accompanied by a loss of 34,570 calories, but the hydrogen thus liberated finds the free oxygen of the water, and, in recombining with it, again reproduces 34,570 calories, so that the loss and the gain compensate each other. If, then, the quantity of free oxygen present in the water were sufficient to combine with the whole of the liberated hydrogen, the electromotive force of the Smee element would be 2·15 Daniell."

Here, again, there is an admixture of some truth with fundamental error. The influence of the free oxygen in retarding "polarisation" is an undoubted fact. But, if M. Exner tries an experiment with the Smee couple immersed in dilute sulphuric acid containing no trace of free oxygen, nor of any element located at the same end of the electro-chemical scale, he will still find that the initial E.M.F. of the Smee cell is considerably higher than that of Daniell, and that "polarisation" grows slowly to a maximum. He will find, moreover, that at first, and until "polarisation" has nearly reached a maximum, no hydrogen is *evolved*, but that this electro-positive component of *sulphate of hydrogen* is deposited upon the platinised silver in a manner analogous to that in which copper from *sulphate of copper* would be deposited upon the same surface. The hydrogen, however, as in the case of zinc deposited on a copper cathode from a sulphate of zinc solution, forms a true and persistent alloy with the cathode metal; and it is only when the affinity of this metal for hydrogen has been satisfied that hydrogen is *evolved*, and "polarisation" reaches a maximum. In the same manner as copper alloyed with a less or greater proportion of zinc forms a more or less efficient negative element in relation to zinc, so platinised silver, alloyed with a less or greater proportion of hydrogen, exhibits to a less or greater extent the phenomenon of "polarisation." The effects of the electro-deposition of *hydrogen*, to which this name is given, may very instructively be studied by comparing them with those obtained by employing as negatives plates of copper upon which *zinc* has been deposited in quantities varying from a minute trace to a complete coating.

NOTE ON THE LENGTH OF A SINGLE CONVOLUTION OF WIRE IN A TELEGRAPH CABLE.

BY F. C. WEBB.

I cannot find in *Clark and Sabine* or any other book a method for finding the length of a single convolution of a wire in a submarine cable, the diameter of the cable and wire and "length of lay" being given. The following may, therefore, be useful :—If a line be drawn as a helix round a cylinder, so as to go exactly one turn round, the line will evidently be the hypothenuse of a right angle triangle, of which the circumference of the cylinder is the base and the distance between the two ends of the helix is the perpendicular. If, therefore, D is the diameter of the cylinder and l the distance between the two ends of the helix, the length of the helix will be expressed by

$$L = \sqrt{(3{\cdot}1416\ D)^2 + l^2}.$$

In the case of a telegraph cable, the length l is the length of cable made by one turn of the machine and is called "the length of lay." To get the length of the wire in one convolution we must take for D in the formula the diameter on the centre line of the wires. Thus if d is the diameter of one of the wires, and D′ the outside diameter of the cable, then we must to get D subtract d from D′. Thus the complete formula for obtaining the length of one of the wires in making a complete convolution is

$$L = \sqrt{\left(3{\cdot}1416\ (D' - d)\right)^2 + l^2}.$$

THE GAS AND ELECTRIC LIGHT EXHIBITION AT GLASGOW.

FROM OUR SPECIAL CORRESPONDENT.

It is rather unfortunate for the success of the electric light that it is usually mismanaged, or, at any rate, behindhand when on public exhibition. Either the lamps have an unlucky habit of going out just when they are wanted to show at their very best, or when they are to be compared with gas-light in a public display the apparatus is so long in being put in order that the first impression of the spectators is in favour of the effect produced by the better-managed gaslights. The gas and electric light exhibition at Glasgow is an important instance in point. While all the numerous varieties of gas jets, large and small, public and private, were in full blaze on the very opening day, September 28th, there was but one electric light ready, and that not one of the most pre-eminent or best known. Jablochkoff's candles, and the lamps of Siemens, Crompton, Rapieff, Werdermann, and Lontin were conspicuous by their absence. Indeed, they are only now erecting the wires for the exhibition of some of these later arrivals, and it will be a week more ere they are on view.

Siemens, Jablochkoff, and Rapieff, are not to be exhibited, we understand; but the British Electric Light Company will display a number of different kinds of Lontin, and of Crompton lamps. A fine effect is to be produced by erecting four lamps on the main tower of the University at Gilmore Hill. There are no absolutely new electric lamps entered; but Brockie's lamp and that of McKenzie are perhaps the least well known of them all. Brockie's lamp, as supplied by the British Electric Light Company, is regulated by allowing the carbons to fall together when the arc gets too wide, and then withdrawing them instantaneously to the proper distance apart, after a manner similar to that employed in the Brush lamps. It has been successfully introduced into the gutta works of Messrs. Dick and Co., Glasgow. M'Kenzie's lamp, like Brockie's, is regulated by re-adjusting the arc at invervals, but the adjusting mechanism is different. The merit of this mode of adjustment is its simplicity and the consequent cheapness of the lamp, as well as its suitability to factories. M'Kenzie's lamp was exhibited by Messrs. P. Watt and Sons, Glasgow, on behalf of Crossley Brothers, Manchester.

With regard to other electrical apparatus, the best display was made by Messrs. D. and G. Graham, of Sanchiehall-street. This firm of telegraph engineers and contractors have rapidly come to the front in Glasgow within the last few years. They have now three telephone exchanges in full operation in Glasgow, in powerful rivalry to the United Telephone Company, working the Bell and Edison instruments. These exchanges consist in one for doctors and other medical men, one for lawyers connected to the courts, and one for commerce; but all three exchanges are together, and a client of any one can correspond with a client of any other. The instruments employed are a microphone transmitter, similar to Crossley's, and the Gower-Bell telephone.

Messrs. Graham exhibit a large assortment of electric and pneumatic call-bells for ships, mines, and offices, besides telephones, burglar alarms, and batteries. A novelty of their own is an electric billiard marker, in which by means of press-keys placed along the edges of the billiard table the score is indicated on two dials by a clock hand. Each press of the key sends an electric current which advances the hand one number at a time by a step. A splendid case of specimen telegraph cables made by the Silvertown Company is also shown by Messrs. Graham.

Another Glasgow firm of electrical mechanicians, Messrs.

* "Dictionary of Electrical Terms." *The Electric Telegraph and Railway Review*, Nov. 12, 1870.

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Anderson and Munro, likewise exhibit a considerable variety of electric bells and indicators, as well as the Gower-Bell telephone for private use. One of their ships' indicators is deserving of mention, because the indicator needle is pivotted diagonally across the electric magnetic bobbin in such a manner that both poles act on the projecting vanes of soft iron which it carries at its ends. The result is a more powerful attraction than would have been the case had only one pole of the magnet acted on the needle. Close beside the stall of Messrs. Anderson and Munro were placed the electrically synchronised clocks of Messrs. George Edward and Son, which are now erected by the Glasgow Corporation in many of the street corners of the city.

With regard to the display of gas lighting and heating apparatus, it was very fine indeed, the favourite gas-stove being that of Dr. Adams, of Glasgow. Sir William Thomson's occulting apparatus for lighthouses was shown, and also a compressed air fog-horn worked by one of Crossley's gas engines.

THE EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY (LIMITED).

The fourteenth ordinary general meeting of the above Company was held at the City Terminus Hotel on the 6th inst., under the presidency of John Pender, Esq., M.P.

The SECRETARY (Mr. F. E. Hesse) having read the notice, and the minutes of the general meeting held on the 14th April last, which were approved, and signed by the Chairman, the report was taken as read.

The CHAIRMAN said: Before making a few general remarks, I will, as usual, give you some few details of the working of the business during the last six months. The gross receipts for the half year ending the 30th of June, 1880, you will observe, were £173,020, and for the corresponding period of 1879 they were £150,107, showing an increase of £22,913. Of this amount, however, only £10,000 is due to increased traffic; the remainder (£12,766) representing additional subsidies received during the half year as follows:—From the Australian Governments, in respect of the duplicate cable, £10,800—that is for four months, or at the rate of £32,400 per annum; from the Government of the Straits Settlements, for Malacca cable, £500, for six months, or at the rate of £1,000 per annum; from the Government of the Philippine Islands, for Manilla cable, £1,466, for two months, or at the rate of £9,600 per annum. The working expenses for the past half year were £49,775, as against £54,950 in the corresponding period of 1879, showing a decrease of £5,175. This decrease is accounted for by the saving in the cost of repairs to cables and the expenses of maintenance ships, which must always be a fluctuating item. As you are aware, the item of repairs is a very uncertain one, and, fortunately, we have had comparatively very few repairs in the last half year. It will also be seen that a sum of £17,500 has been charged against the revenue of the half year to meet the interest on the Company's 5 per cent. Government subsidy debentures, and a contribution of £6,000 to the sinking fund for the redemption of the same. The net revenue, therefore, for the half year is £95,535, against £84,597 in the corresponding half of 1879, showing an increase of £10,938. The dividend already paid during the half year was 1¼ per cent., absorbing £24,968, and it is now proposed to distribute another of like amount, together with a bonus of 1s. per share, payable on the 15th inst., making a total of 3 per cent. for the half year. The balance carried forward—I should rather say carried to the reserve—is £35,610, against £34,660 in the corresponding period of 1879, when 2½ per cent. dividend was paid. Now, gentlemen, it will be in the recollection of many of the shareholders who are here present that when I addressed you six months ago, when the question of the dividend arose, I stated it was most desirable that we should have a large reserve fund [hear, hear], but that if in the course of the six months we found that our traffic was keeping up and that we could still put to the reserve the same amount as in previous half years, we would consider the question of increasing the dividend [applause]. We have always had in view the desire to meet as far as possible the wishes of our shareholders. At the same time, being entrusted with the management of the Company's affairs, and knowing perhaps better than any individual shareholder can do the importance of having a strong reserve, we have always held that the reserve was, after all, an important consideration; and I think the best evidence I can give you of the value attached to a good reserve is to point out that your shares, which two years ago were at something like 8—[A Voice: "7"]—are to-day at a premium. Now, if we had expended in dividends all the money we were earning, you may depend upon it that the shares would not be in the position in which they stand to-day. We are now enabled to put aside as good a reserve as we did when we were paying you 5 per cent., and to pay you a bonus which is equal to 1 per cent. per annum, making the dividend 6 per cent. Now I wish to make a remark with which I am quite sure you will all agree. This property has been a very progressive one, but, at the same time, it must be probably an uncertain property, because it is at the bottom of the sea, and consequently a good deal beyond our control, although every year we begin to realise the fact that it is more within our power, and becoming more a property, because we now know better how to deal with it. We are, therefore, determined to keep a steady uniform dividend of 5 per cent., and to distribute surplus profits by way of bonus, which would, of course, fluctuate. This half year it is ½ per cent. I should be delighted to see it extend, but, at all events, we will endeavour to maintain our 5 per cent. steadily, and, as I have said, the bonus will be a fluctuating item. I think this view, if it is fully understood and appreciated by the shareholders, will add greatly to the value of our property. I am glad to say, gentleman, that I have never addressed you at any period when I could say that your affairs were in a better state than they are at the present time. Our cables are all working very satisfactorily, and the new cable to Manila we have just opened is earning beyond the calculations that we put before you when we asked you to grant the money for laying it. I may also mention that we have had very good luck in regard to that cable. It was no completed more than a couple of months when there were earthquakes at Manila, but as it was laid about 120 miles from Manila, we escaped entirely from any damage to our property What is one's misfortune is another's benefit, and there is no doubt that the earthquake gave considerable impetus for the moment to our traffic. However, I hope that our traffic will continue to grow upon a more solid basis than the results of earthquakes, and that I am satisfied will be the case. Now, gentlemen, there is another point that I wish to mention, showing the importance of our telegraph system, and how close it brings the nations together. The exhibition at Melbourne was opened on the 1st of October, and within twenty-three minutes of the opening of the exhibition we received a message in London announcing the fact [applause]. I think that is probably an unprecedented incident, especially when it is borne in mind that the telegram passed over 4,328 miles of land cable and 9,070 miles of submarine cable. All the links in the great chain which connects our vast colonial empire with this country worked so perfectly that in 23 minutes we were able to despatch a message to Her Majesty that the Melbourne Exhibition was open and a great success. I may also mention that the telegram we received consisted of 69 words. Now, gentlemen, I think that that is a great "feather in our cap," as showing that the system, taking it from first to last, is in a very perfect and efficient state for doing good service to the public and, I hope, very good service to the shareholders. With these remarks I beg to move the adoption of the report.

The VICE-CHAIRMAN (the Right Hon. W. N. Massey, M.P.): I beg to second that.

The CHAIRMAN: It has been moved, and seconded by Mr. Massey, "That the report and accounts of the directors now submitted be received and adopted." Before putting the resolution, I shall, as usual, be glad to hear any gentleman who may wish to address the meeting.

Mr. JOHN NEWTON: I should just like to draw attention to an alteration in the accounts which you have made in the last two half years, and also in this—in the lumping together in one item of that very large sum of £17,703 7s. 2d. for repairs and renewal of cables, including expenses of ships in harbour. In former accounts, sir, you divided that item, showing us what was the cost of the ships when they were unemployed in repairing. We were enabled by that system to judge what was the cost of the repairing ships each half year. I think, sir, when you divide an item of £3,327 (general expenses in London) in nine divisions or nine lines that you might continue the division of that large sum of £17,703, as in former accounts, and show us what we spend on these ships when they are not doing anything for us, and also what is the actual cost of the repair of the cables. That is a most important item. It is most important that we should know every half year the cost of continuing and maintaining our lines in an efficient condition, apart from the cost which is entailed on us by having perhaps too many ships for the work. We have two or three ships, and I should like to know what they cost us when they are not doing anything.

The CHAIRMAN: In reply to Mr. Newton's remarks, it is quite true that we are obliged, so as to keep our accounts in something like moderate compass, to lump some of these figures together, and in this instance we have done so. We have done the same in the Eastern Company, but we are always prepared at meetings like these to give any detailed information that may be asked in reference to the accounts. Our accountant is entirely responsible for these accounts, and it is a very good thing that he should be. He has mentioned that it would give such an amount of detail that it would require much larger——

Mr. NEWTON, interposing: Only one more line.

The CHAIRMAN: You would have three or four. Besides, I don't know that it is necessary when we are quite prepared to give the details. It is a very fluctuating item, and I don't think it amounts to much whether it is a detailed sum or lumped together, if we are prepared to answer any question you put in regard to the item.

Mr. GUESDON: I think anyone who knows anything about ship's accounts will know that the wear and tear and depreciation of a ship are easily kept distinct from the ordinary expenses; and, therefore, I don't think that a great deal of trouble would be involved in the accountant's department in distinguishing items which are perfectly distinct in themselves, and show in the accounts that information which should not be expected to be asked for by the shareholders.

The CHAIRMAN: I am quite prepared to give you it. We do not desire to keep the information back, but to show the accounts in something like a form that will be in a moderate compass. The screw steamer "Sherard Osborn" cost £2,501 5s. 3d.—she was in harbour; the "Agnes," £3,556 3s. 9d.; and the "Southern Ocean," £2,165 13s. 5d. That is a ship that we bought for storing and repairing our cables, which we find to be very much cheaper than having the work done on shore. Repairs to cables cost £9,480 4s. 9d., together £17,703 7s. 2d. We are always prepared to give you this information.

Mr. NEWTON: May I suggest that instead of giving it in such ample detail as in the half year of 1879 you should lump in one line the cost of maintenance ships when in harbour and then that of those that are employed.

The CHAIRMAN: We adopt what we believe is best under the advice of one of the first chartered accountants in the city of London; we submit the accounts in a form which he considers the proper form to put before shareholders. We have always the details before us, and are always prepared to give them to you as I have given them to you now. As my speech will be printed the information will go to the shareholders in a better way than if the sums had been lumped together.

Mr. NEWTON: But I submit, sir, that your answer is not satisfactory, and I must tell you that when the shareholders receive this document (referring to the report and accounts), it is of the first consequence to them; it is more important that they should have that one line, and know what is the actual cost of repairing the cables, than almost all the other details. The amount we pay for renewing our cables is the worst item that you can have separated, and I maintain that it is not for the shareholders to look for newspaper reports or subsequent documents that are sent out by you. On former occasions we have had the item, and I protest against the system of any chartered accountant or any other man having to deal with our figures, altering the form of the accounts, so that we can never get a proper com-

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parison. I submit that you should put it to the meeting whether we should have that item separated, so that we may know if there are too many ships or not.

The CHAIRMAN: When these Companies were formed I expressed a very strong opinion that our accounts should be entirely in the hands of the most competent accountant we could select. These accounts are strictly audited, not every six months, but from day to day, and therefore the accountant is responsible for every item in these accounts, and he puts them before you in the form he considers correct and right, as he will justify in the remarks he desires to make.

The AUDITOR: Mr. Chairman and gentlemen, the alteration to which Mr. Newton refers in the accounts has been done, I think, for good reasons, and has been advantageous in enabling you to compare the results of one half year with another. The ships are only in harbour, naturally, when they are not engaged in cable work, and if we give you the information as to the cost of each steamer when it is in harbour, to make it of any value whatever you ought to know how many days it is in harbour; and, on the other hand, you ought also to know how many days each steamer is engaged in repairs, and to give so much information as that in the accounts we thought was more than was necessary, and at the same time without such information we thought was valueless. As a matter of fact the expenses of the ships, whether engaged in repairing or not, are distinctly chargeable to the cost of keeping your cables in order. They are kept for no other purpose, and therefore the whole expense is put together. As Mr. Pender points out, the details are always at the service of the shareholders.

Mr. GUESDON: I see no reason why you should blend these items together.

Mr. W. FORD: I think, sir, that the question may be safely left to the auditor, who will probably, after this expression of opinion, give the information in an additional line. It does appear to me, from the figures quoted by the hon. chairman, that he can do so without giving much detail.

The CHAIRMAN: I think, as I said before, that it would be very undesirable that your directors should endeavour in any way to influence your accountant [hear, hear]. We leave him to deal with it, and if from the expression of opinion he has heard to-day he considers it is desirable after this to give further details it is for the accountant to do so. It will never be said that your board are instructing your auditor in any way to arrange the accounts to make them pleasant for the shareholders. You will have the statement of these accounts made in such a way as will, I hope, be perfectly satisfactory to the body of the shareholders. After all, as the accountant has said, the ships are simply kept for repairing the cables, and nothing else, and if you see £17,000 charged for repairs and ships you know that that has been expended either in repairing the cables, or while the ship was in harbour. It is part and parcel of maintaining your cable system. I think we can now pass from that.

Mr. VARLEY: I should just like to say a few words on a subject of importance—the investments forming the reserve fund. I notice that a large amount of Portuguese stock has been bought. My opinion is that the reserve fund should be put in something that is not fluctuating [hear, hear], and some may think that the Portuguese stock is too low, or that it is too high. I have known it at 37, and I think the reserve fund should be put in stock that does not fluctuate. That is the only detail on which I can offer the least criticism.

The CHAIRMAN: I must say that I am always rather pleased to invite criticism on the reserve fund. This Portuguese stock has been frequently talked about at the Board, and the conclusion we came to was that the amount was not large, that we were getting a very considerable rate of interest on it, and that it was scarcely worth while changing it at the present time. But at the same time there are gentlemen who hold the same opinion as you have expressed about Portuguese stock, and I think, as it has been referred to, I see no reason why we should not change it for some other stock.

The CHAIRMAN put the motion in the usual way, and declared it carried unanimously. Continuing, he said: The next resolution is "That the Board of Directors be and are hereby authorised to make and carry into effect, and if they think fit from time to time to alter and vary arrangements for assisting the *employés* of the Company in effecting insurances upon their lives, and for this purpose to pay out of the revenues of the Company such sums as they may from time to time deem expedient, not exceeding in any case one-half of the premium required." Gentlemen, this has been adopted by the Eastern Company, by the Anglo-American Company, it has been adopted by the Direct Company, and I think by the Brazilian Submarine Company. I have stated on a previous occasion that the great object that we have in view is to secure a superior class of young men in our service. A great many of our stations are in a distant part of the world, and we must have a very superior class of young men. The work they have to do is very peculiar—trying work to the brain and the eyes, and, therefore, we think it is desirable to help them in providing for a time when they probably may not be equal to the work. It has been unanimously supported by the other companies that I have mentioned, and I hope that the Eastern Extension Company will follow in the same good course, so as to secure a class of young men who will not only be proud of the service, but of whom we shall also be proud. As you know, we must trust them a good deal. They are entirely beyond our observation. We can only judge by results that they do their work well, and we feel, as they are very much in our hands, that we ought to treat them generously and fairly, so as to secure their confidence and their best efforts in carrying on this work, in order to make it as nearly perfect as possible. With these remarks I beg to move the resolution.

COLONEL GLOVER: I beg to second it.

MR. GUESDON: Before that is put may I ask you to alter one word? In the last line [in the paragraph in the report dealing with this subject] you say "about £1,500 per annum." I wish the directors to name that sum in their resolution. If it is not found sufficient it will be easy to take a supplemental vote at another meeting. "About £1,500" is indefinite.

The CHAIRMAN: We have not the slightest objection to put that in. If the thing is a success we can extend it.

Mr. FORD: Say "not exceeding."

The CHAIRMAN: We have no objection. Then it is not exceeding £1,500 per annum.

A SHAREHOLDER: Do I understand that the *employés* are at liberty to insure their lives in any company they please?

The CHAIRMAN: No; we have arranged terms with the Northern Assurance Company.

A SHAREHOLDER: Then if one of the *employés* felt disposed to go to another company ——

Sir JAMES ANDERSON: We should not get the same terms. The assurance company agrees to take all the lives as they are. That could not be done with any other company.

The CHAIRMAN then put the motion and declared it carried unanimously. Now, gentlemen, that closes the business of the meeting.

Sir FRANCIS LYCETT: I beg to propose a vote of thanks to the Chairman.

Mr. MARCUS (a Shareholder): I will second that.

The resolution was then put and carried unanimously.

The CHAIRMAN: I beg to thank you on behalf of myself and co-directors. We have only one object in view, and that is to make the Company prosperous, and we shall continue, I hope, to give evidence of that.

The proceedings then terminated.

ABSTRACT OF PATENTS.

5127. ELECTRIC LAMPS, &c., *T. A. Edison.—Dated 15th December*, 1879. 6*d*.

This relates to an improvement in the process of manufacturing the carbon filament, and the means of securing the same to the conductors.

5156. ELECTRIC LIGHT REGULATORS, *S. Pitt.—Dated 16th December*, 1879.—(*A communication.*) 8*d*.

This relates to apparatus which, first, separates the carbon points to the proper distance for the display of the electric arc when the current is first established; secondly, feeds forward one of the carbon pencils to compensate for the waste which takes place so long as the current is passing; thirdly, when the current is turned off, or when from any cause the current ceases to flow, instantaneously brings the carbon points into contact.

5157. MAGNETO-ELECTRIC MACHINES AND ELECTRIC LIGHT APPARATUS, *H. F. Joel.—Dated 16th December*, 1879. 16*d*.

This consists essentially of an arrangement of inducing electro-magnets or permanent magnets with induced electro-magnetic armatures, whereby great surface is brought into magnetic action, and a special induction current is produced, and distinct and separate circuits are formed for exciting the inducing electro-magnets, and for feeding a light or motive power engine at one and the same time from one machine.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES OCT. 6.		BUSINESS DONE WEEK ENDING OCT. 6. Highest.		Lowest.	
Anglo-American Ordinary	64½,	¾	65¼		64⅝	
Do. "B"	95½,	96	96⅛		95½	
Do. "A"	34½,	¾	35⅛		34½	
Brazilian	9 9-16,	11-16	9 11-16		9 3-16	
Cuba	9,	½	9½		9¼	
Do. Ten per Cent. Pref.	16½,	¾	—		—	
Direct Spanish	1⅞,	2¼	—		—	
Do. Ten per Cent. Preference	11⅞,	12¼	12¼		12¼	
Direct United States	12⅛,	¾	12⅞		12⅝	
Eastern	9⅞,	10	10		9¾	
Do. Six per Cent. Debenture	106,	109	—		—	
Do. Five per Ct. do. 1899	103,	106	104⅝		104½	
Do. Six p Ct. Pref	12½,	¾	12¾		12½	
Eastern Extension	10 3-16,	5-16	10⅜		10⅛	
Do. Six per Ct. Deb	108,	111	—		—	
German Union	9¼,	⅝	9⅝		9⅜	
Globe Telegraph & Trust	6 13-16,	15-16	6 15-16		6 13-16	
Do. Six p Ct. Preference	12 3-16,	5-16	12⅝		12⅜	
Great Northern	9⅞,	10	10		9 13-16	
Indo-European	24½,	25½	25½		25	
Mediterranean Extension	2⅞,	3¼	—		—	
Do. Eight p Cent. Pref	10¾,	11¼	11		11	
Reuter's	10½,	11½	—		—	
Submarine	242,	248	246		246	
West India and Panama	1 5-16,	7-16	1 7-16		1⅜	
Do. Six per Cent. 1st Preference	7,	¼	7⅛		6 15-16	
Western and Brazilian	7½,	⅜	7⅝		7 5-16	
West. Union 7 p. Ct. 1st Mt.	120,	125	—		—	
Do. Six per Ct. Sterg.	102,	104	103		10	

TRAFFIC RECEIPTS FOR SEPTEMBER, 1880.

COMPANIES.	Sept., 1880.	Sept., 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	1,800 estd.	3,314	—	1,514
Direct Spanish Telegraph Company	1,53	1,1	41	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	43,717	39,3	4,3	—
Eastern Extension Telegraph Company	28,771	26,		—
Great Northern Telegraph Company	22,320	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	North Sea.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	—	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	St. Pierre.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia..	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

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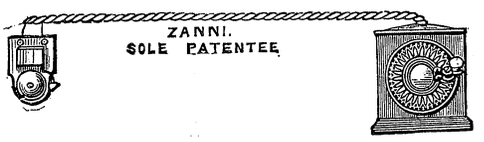
ZANNI  & CO.,

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Ages at Entry.	NUMBER OF PREMIUMS PAID.					
	Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	——	——	787 10 0	517 0 0	310 10 0	137 10 0

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SLIP

NATAL.—The Governor has informed the President of the Free State that a telegraph line will at once be constructed from Ladysmith to Harrismith.

TELEPHONIC COMMUNICATION.—Goole is being telephonically connected with Castleford and Leeds. This is being done by the Aire and Calder Navigation.

SPEED OF WORK.—M'Cullock's "Dictionary of Commerce," new edition, says, "A good operator can send 2,000 words per hour," but it does not say under what conditions.

TELEGRAPH POSTS.—The Plumstead Local Board adhere to their decision not to allow telegraph posts to be erected along the road from Shooter's Hill to Eltham, to connect the Fire Brigade stations to those places.

GLASGOW.—We understand that the new station of the North British Railway Company, Queen-street, Glasgow, is to be lighted by the electric light on Crompton's system. This station is 900 feet long by 180 feet broad.

THE LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY.—This company announces for the six months ended with September 30, an interim dividend of 2s. 6d. per share, tax-free, payable on and after the 1st of November.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—This Company notifies that the interest due 15th October, 1880, on their 6 per cent. debenture loan will be paid on and after that date at the Consolidated Bank, Threadneedle-street, E.C.

THE ELECTRIC LIGHT IN THE CITY.—No decision has as yet been made by the Commissioners of Sewers for the adoption of any particular system, but a committee is gathering information for a full and impartial consideration of all the systems submitted in competition.

ST. MICHAEL'S CHURCH, CORNHILL.—The income of this church is estimated at £3,000 a year. The prodigality of the expenditure may be estimated from the statement that, in order to give the organist complete control over the choir, electric communication has been made from his seat on one side of the church to the organ on the other.

PRICES.—As compared with last week, the price of gutta percha is slightly firmer. Genuine is quoted at from 6d. to 2s. 3d. per lb., reboiled from 3d. to 1s. India rubber is quoted per lb.: Para (fine) 3s. 2d., Negrohead 2s. 3d., Central American 1s. 9d. to 2s. 3d., Assam and Pegu 9d. to 2s., other East Indian 1s. 4d. to 2s., and Madagascar and Mozambique 1s. 7d. to 2s. 3d.

PHOSPHORESCENT LIGHTING.—Dr. Phipson takes sulphide of barium, or some other substance which is rendered phosphorescent by the solar rays, and encloses it in a Geissler tube, through which he passes a constant electric current of a feeble but regular intensity. He claims to obtain in this manner a uniform and agreeable light, at a cost lower than that of gas.—*Les Mondes.*

CABLES.—In another column we give an article which appeared in a Boston contemporary. We have reason to believe that there is little new in Mr. Choate's work. At any rate, Mackintosh many years ago patented a method of having a relay in mid-ocean, whilst a few years ago Mr. FitzGerald patented an invention having for its object the increase of speed in cable signalling, and recently Mr. Blarney has obtained a patent for a somewhat similar object.

THE ELECTRIC LIGHT FOR THE MERV EXPEDITION.—We understand that the Jablochkoff Electric Company in Russia have just completed, under the personal supervision of Professor Jablochkoff himself, three machines specially designed for use at Krasnovodsk, where General Skobeleff intends making use of the electric light during the impending debarcation of Caucasian troops there for the Turkoman campaign. The three machines, with nine lanterns, some reflectors, and 2,200 candles, leave St. Petersburg this week for the Caspian —*Globe.*

PERSONAL.—Baron John Denormann, the Mediterranean Extension Telegraph Company's agent in Corfu, has recently been created a Knight of the Order of the Crown of Italy, third class.The diploma and decoration were accompanied by a most gracious letter from Signor Cairoli, the Italian Prime Minister, explaining that the order was given in recognition of his past services in Italy, and for assistance rendered to Italians abroad. Baron Denormann originally served under the Bourbon at Naples, where he introduced a very important modification in the Calland battery, now universally adopted by Italy, and known as the "Pila Italiana."

ELECTROLYTIC ESTIMATION OF SILVER (by H. Fresenius and F. Bergmann).—Luckow first proposed to estimate silver electrolytically (*Dingl. Polyt. J.*, 178, 43; see also *Zeit's Anal. Chem.*, 1880, 1; this vol. 282). The authors have re-investigated his process, and recommend the following method of procedure, the battery and electrodes being the same as mentioned in the Abstract. 200cc. of solution should be employed, containing 0·03—0·04 gram of silver and 3—6 grams free nitric acid. The electrodes should be 1 cm. apart, and the strength of current capable of evolving 150cc. of mixed gases from water per hour. The silver separates in compact metallic form on the negative pole, no silver peroxide being deposited on the positive.—*Chem. Soc. Jnl.*

INFLUENCE OF THE GALVANIC CURRENT ON BACTERIA (F. Cohn and B. Mendelshon).—The authors carried out their experiments to verify the assertion of Schiel, that the galvanic current prevented the development of bacteria. The results were that a feeble current from one pair of elements had no perceptible effect; a current from two elements rendered the solution inactive at the positive pole; a current from five, continued for twenty-four hours, completely sterilised the whole solution, and deprived it of its power to infect another solution. The solution at the positive pole was first affected; with the stronger current the liquid became acid at the positive and alkaline at the negative pole. The induction current had no perceptible effect on the bacteria.—*Jnl. Chem. Soc.*

EFFECT OF AGE ON THE QUALITY OF IRON.—Professor Bauschinger, in 1878, tested iron taken from a chain bridge built in 1829, and found that fifty years of use had not perceptibly altered its quality—either its strength or its elasticity—as reported at the time of its erection. He also examined metal from another bridge built in 1852, and found that the average quality remained as given by Von Pauli at the time of its erection. Professor Thurston, testing pieces of the wire cable of the Fairmount Suspension Bridge, recently taken down at Philadelphia, after about forty years' use, found the iron to have a tenacity and elasticity and a ductility fully equal to the best wire of same size found in the market to-day. He, therefore, concludes that iron subjected to strains such as are met with in properly designed bridges does not deteriorate with age. It would be interesting to know the effects of age on iron wire as used for telegraph purposes.

SUBMARINE TELEGRAPHS.—Seventy miles of submarine cable for the repair of the West India and Panama telegraph was despatched from the works of Mr. Henley, North Woolwich, on Tuesday, in the telegraph ship "Duchess of Marlborough." She will be joined at St. Thomas's by the company's ship

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"Grappler," and they will proceed together to find the fault which has suspended communication and repair it. In several recent instances in which repairs of this description have become requisite, it has been found that the cable has been deliberately cut, and it is said to be the practice of ship's crews when their anchor's foul and drag up the cable to set themselves free with a blow of the hatchet rather than take the trouble of rigging up the tackle necessary to lift the cable over the fluke of the anchor. The Peterhead and Denmark Telegraph cable, which was recently found severed in this way, was otherwise as sound as when it was laid down seventeen years since.

Synthesis of Alcohol.—Writing to *La Nature*, M. E. Lapeyière says:—In the porous vessel of a small-size Bunsen cell, I replaced the nitric acid by a concentrated solution of very pure crystallisable acetic acid; the external compartment containing very dilute sulphuric acid. I then short-circuited the cell, and left it in action during a certain period (from April 29 to May 27). At the end of this period, the acetic acid had disappeared from the porous cell; being replaced by alcohol in sufficient quantity to allow of my obtaining a few grammes of this substance by distillation. As I had foreseen, the acetic acid assimilated the hydrogen necessary for the production of alcohol. M. Lapeyière found by a further experiment that the acetic acid was first converted into aldehyde, and afterwards, by a further absorption of hydrogen, into alcohol; the successive changes being expressed by the following equations, in the equivalent notation:—

1. $C_4H_4O_4 + 2H = C_4H_4O_2 + 2HO$;
2. $C_4H_4O_2 + 2H = C_4H_6O_2$.

Use of Telegraphy in the Detection of Criminals.—The following remarkable example of the use of telegraphy in the capture of criminals, says the *Aberdeen Evening Express*, is worthy of passing notice: A man was "wanted" in Norway on a criminal charge. The Norwegian authorities, after careful inquiry, had ascertained that the fugitive had left for Scotland, with the intention of taking passage by the first steamer sailing from Glasgow for America. The criminal had a start of two or three days, and not a moment was to be lost. At seven minutes before seven o'clock p.m. a telegram describing the man, in about forty words, was put on to the Norwegian end of the North Sea Cable, which enters Scotland at Peterhead. There is a slight difference between the time at one end of the cable and the other. At four minutes before seven o'clock the message had passed through Peterhead to Aberdeen, whence, after translation, it was forwarded to Glasgow. The detectives of St. Mungo received the message a few minutes past seven o'clock, and the next trans-Atlantic liner was to have sailed at fifteen minutes past seven with the wanted man on board. Before the posted sailing time, however, the Norwegian was in custody, having been arrested on the steamer by the Glasgow detectives. It is a significant fact that within thirty minutes of the time of the despatch of the Norwegian telegram to this country a return message was on its way from Glasgow to Norway announcing the capture and safe custody of the criminal.

Edisonia.—Edison has written an article in the *North American Review* on the electric light. Writing of his own lamp, he says:—"The perfected lamp consists of an oval bulb of glass about five inches in height, pointed at one end, and with a short stem three-quarters of an inch in diameter at the other. Two wires of platinum enter the bulb through this stem, supporting the loop or U-shaped thread of carbon, which is about two inches in height. The stem is hermetically sealed after the introduction of the carbon loop. At its pointed end the bulb terminates in an open tube through which the air in the bulb is exhausted by means of a mercury pump till not over one-millionth part remains. The tube is then closed. The outer extremities of the two platinum wires are connected with the wires of an electric circuit, and at the base of a lamp is a screw by which the circuit is made or broken at pleasure. When the circuit is made the resistance offered to the passage of the electric current by the carbon causes the loop to acquire a high temperature and to become incandescent, but as this takes place in a vacuum, the carbon is not consumed. The 'life' of a carbon loop through which a current is passed continuously varies from seven hundred and fifty to nine hundred hours. With an intermitted current the loop has an equal duration of life, and as the average time an artificial light is used is five hours per day, it follows that one lamp will last about six months. Each lamp costs about fifty cents, and when one fails another may be easily substituted for it." The inventor promises a demonstration shortly in Menlo Park. Shall we again attempt to foretell events? If so, let us say that, according to present advices, Edison has been forestalled by an English inventor, and that it is pretty certain whatever has been done in America will be found not to advance matters. Look to Newcastle, not to Menlo Park.

Electrolytic Determination of Metals (by L. Schicht, *Chem. News*).—Uranium, from alkaline solutions (containing tartaric, citric, or acetic acids, or mixed with sugar), or from neutral solutions, is separated only to a very small extent with a yellow colour. In presence of mineral acids it is not precipitated, but is reduced from uranic to uranous oxide. Thallium is not precipitated from acid solutions, but is completely precipitated on the negative pole, with brisk disengagement of gas; from ammoniacal solutions, blackish-brown thallium oxide, much resembling lead peroxide, being deposited on positive pole, imperfectly precipitated from neutral solutions on account of the acid liberated. The oxide dissolves in hydrochloric acid with evolution of chlorine. Iridium is completely precipitated, as metal at the negative pole, both from acid and alkaline solutions; in the latter case the metal is very bright and firm. Vanadium: No precipitation, but merely reduction in alkaline or acid solutions. Palladium nitrate, acidified with nitric acid, is deposited at the negative pole as bronze-coloured coating, which becomes darker and finally black. Some reddish oxide forms at positive pole. Alkaline solutions behave similarly, but the composition is slower and more adhesive. Molybdenum, from an ammoniacal solution of molybdic anhydride, is completely and firmly deposited at the negative pole as molybdous oxide as coloured rings, which thicken and become black. The first blue precipitate is molybdic molybdate, then follows molybdic and molybdous oxides. In acid solutions there is no precipitation, in ammonium molybdate acidified with molybdic anhydride there is incomplete precipitation. Selenium is completely thrown down both from acid and alkaline solutions. If the current be strong, the deposit is pulverulent. Tellurium behaves like selenium, but is deposited much more readily in acid solutions with a blue-black colour, in alkaline solutions in a very loose state at the positive pole, with strong disengagement of gas. Gallium, like zinc, is thrown down completely at the negative pole in a pure state.—*Chem. Soc. Jnl.*

The Postal Telegraph Department.—We make the following extracts from an article in the *Pall Mall* on "Administrative Reform—the Rearrangement of the Estimates":—There ought to be no hesitation in separating the cost of the Post Office and of the Telegraphs from that of the

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Civil Service and the other revenue departments. The public ought to receive in the case both of the Post Office and of the Telegraphs the same information which every railway company supplies to its shareholders. In the case of the Post Office, indeed, there is, happily, no capital account; but in the case of the Telegraphs there ought to be a distinct capital account and a distinct account of revenue and expenditure. The charge of the Telegraph debt should be transferred to this account, and if, unfortunately, the profits of the Telegraphs should be insufficient to meet all the charges of the department, there should be an account, similar to that adopted by the Indian guaranteed railways, of the advances made from the Exchequer for the purpose of supplying the deficiency. . . . It may perhaps be objected that the recommendations which have thus been made involve no real economies. They only suggest certain transfers of charges. But the first advance towards economical reform should probably be made by effecting transfers of this character. If the Postal and Telegraph Departments are required annually to produce an account showing their gross cost, their net revenue, and their estimated expenditure, the persons responsible for the administration of these departments will have a very different inducement to that which they feel now to economise their outlay. And this result will be further secured by compelling the Postmaster-General to make an annual statement in committee similar to that which is always now made by the Secretary of State for War and the First Lord of the Admiralty. A regular debate will in this way occur on the estimated expenditure of the Post Office and of the Telegraph Department; and the Postmaster-General will have personally to defend his proposals, just as the heads of the War Office and of the Admiralty have now to defend their own estimates.

Rapid Telegraphing.—The transmission to Cincinnati on Friday night of the full text of Senator Conkling's speech at the Academy of Music, New York, is worthy of mention. The speech was transmitted by the Phillips system of steno-telegraphy in five hours and five minutes. This is a process of transmission done entirely by hand, and the despatches are received by an ink recorder of great simplicity, which pays out a narrow strip of tape, on which the matter is plainly printed in linear characters. The wire was worked without a "repeater," and the amount of matter transmitted, sixteen thousand words, was fully equal to what would be averaged by the Morse system on three wires, by three senders and three receivers. The speed attained may be more fully realised when it is remembered that Mr. Conkling spoke for three hours and forty minutes, and that his utterances were transmitted in five hours and five minutes, the entire speech being in the Cincinnati *Gazette* office one hour and twenty-five minutes after Mr. Conkling ceased speaking, although he had been talking fifteen minutes when the work of transmission was begun. Despatches transmitted by Mr. Phillips's method require no preparation whatsoever, the operator sending from the manuscript. Steno-telegraphy is the invention of Mr. Walter P. Phillips, the well-known telegraphic expert, now agent of the New York Associated Press in this city. He challenges the inventors and exponents of any and all "phantom circuit," "automatic," or other known systems of telegraphy, as practised either in this country or in Europe, to equal with one man on a similar stretch of wire the amount of work performed as above described, and he avows his ability to produce a plentiful supply of manipulators who can duplicate this record without difficulty. The inventor further maintains that, by the introduction of steno-telegraphy, press matter can be handled at treble the speed now attained, and consequently at a reduced cost, since the system not only increases the capacity of single wires, but, being applicable to "duplexes" and "quadruplexes," renders the former equal to six instead of two, and the quadruplex equal to twelve instead of four wires as at present. The Phillips system carries every punctuation mark used in printing, italicises all words from foreign languages, names of newspapers, &c., and secures the delivery of copy properly punctuated and edited for the compositor. The art of sending and reading steno-telegraphy can be learned by Morse operators in the course of seven days, while the knack of transcribing the tape can be acquired by non-professionals in from three to five weeks.—*Washington Republican.*

Telegraphs at Home and Abroad.—A contemporary says:—"The altered condition of the English Post Office since it deserted its proper functions, and began to convert itself into a ministerial money-making establishment, is aptly illustrated by a return recently published of the telegraph offices now existing in Europe. The *Bulletin Mensnel* issued by the French Ministry of Public Works a day or two ago, gives the number of such offices established at the present time in most of the countries of Europe side by side with the numbers in 1872. According to these statistics, the order of nations at the earlier date showed a great superiority in favour of Great Britain, which stood first on the list with a total of 5,173 offices. France stood second, with the very inferior total of 3,271, Austria-Hungary third, with 2,162, Germany fourth, with 2,050, while Italy, Russia, and the other nations followed with much lower numbers. It might have been reasonably expected that Great Britain having taken so decided a lead would either maintain its full advantage or, at least, keep some small distance ahead of less enterprising and industrial nations. But the figures show that whereas all other countries have advanced, some of them with great strides, this country has remained almost stationary, and has added only a paltry number of offices, which the *Bulletin* reckons at less than 100, raising the total to 5,273. In the meantime Germany, which very properly devotes the utmost attention to postal improvements, has actually quadrupled the number of its telegraph stations, and now possesses no less than 8,222. France has also made important steps in the same direction, and stands very close behind England with a total of 4,722 offices. Russia has more than doubled the number of its stations; and, in fine, all the civilised countries show advances which altogether put to shame the miserable stagnation of the English postal arrangements. The increase of telegraphic offices in the twelve chief countries of Europe has been in the seven years 12,500, or 75 per cent., whereas the increase in this country amounts to about 3 per cent. It may, no doubt, be said that the telegraph was earlier introduced into England than in many of the foreign countries; but no such plea can excuse the stagnation of the last seven years, especially when it is remembered what a high price, relatively speaking, is charged for the most simple messages transmitted by the English offices, and the growing inadequacy of the letter post to meet the requirements of the age." Our contemporary evidently does not understand that a country fairly well supplied with offices does not increase its number of offices in the same ratio as one not so well supplied at the time both started in the list of comparison. In fact, the whole of the above paragraph as quoted shows how extremely ignorant such writers are in matters they write about.

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LITERATURE.

The Electric Light for Industrial Purposes. By R. E. CROMPTON. [Mansion House-buildings, E.C.]

Mr. Crompton has collected in a pamphlet of some forty odd pages a large amount of information which he, in his capacity of engineer and contractor, has felt to be wanted. He commences by referring to the systems of electric lighting in use, grouping them in classes, and pointing out that practically the incandescent class, and that using alternate currents, can hardly be said to be past the experimental stage, or to have been economical or successful when tried. The greatest advance has been made with the system employing direct currents; of such machines we are told there are upwards of 2,000 in Europe and America. With regard to motors there is little or no difficulty. Mr. Crompton says first-class engines can be had from fifty different builders, and speaks in high terms of the engines supplied by Marshalls of Gainsborough, and Ransomes of Ipswich. A good deal of information is given about machines, and the experiments made with them are carefully criticised. The author adopts the suggestion of Mr. Preece as to measurement of lighting power, viz., the ground area lighted to a certain standard. The tables given deserve careful consideration. In speaking of lamps, Mr. Crompton admits a bias towards his own lamp, which he fully describes and illustrates. Another good feature is the discussion on carbons. Those producing the electric light know how important it is to have good carbons and how difficult it is to obtain them. Mr. Crompton states the defects carbons are liable to, and mentions the defects in various makes. At the end he gives a list of prices which will enable the reader to obtain a fair idea of the cost of such lights for a variety of purposes.

A NEW CABLE SCHEME.

Revolutionising the Present System of Working Submarine Lines —Important New Inventions and Methods—Their Manufacture in this City—The American Cable Company—An American Enterprise.

During the past few months a number of electricians and others concerned in a company under an American charter for construction of new ocean cables with greatly improved systems for transmitting and receiving have been occupied in supervising the manufacture of new inventions and instruments, which are destined to revolutionise the present system of working submarine cables. The work has been pursued necessarily with great secresy, but from time to time it has been examined by several scientists, and during the meetings of the American Association in this city by several of its most prominent members. The instruments, all constructed in this city, have been set up in a large room in the Equitable building, and, in connection with a complete and fully equipped model ocean cable, have been tested with great care and thoroughness by the inventor and electricians of established reputation. Now that these instruments have been fully perfected, the tests have been made to the satisfaction of all, and that endorsements have been obtained from unimpeachable authority, a description of the inventions and the changes and improvements they are intended to accomplish is permitted. The various apparatus form a new and complete system for working submarine cables and land lines, and they are: A submarine repeater; relays to be used in connection with the submarine repeater, and by means of which the sound system, the type printer, and the automatic systems can be used on cables, whereby the speed may be increased manyfold over the present modes; type printers of mathematical construction, which are capable at their full capacity of printing fifty-eight Roman letters per second, or 3,480 per minute—or, allowing six letters for the average word, printing over 500 words per minute, while their practical speed is determined by the skill of the operator only; and instruments for working the automatic system on cables.

Of the several inventions most important is the submarine repeater to be submerged in mid-ocean. This consists of a bronze globe, or spherical case of some six inches diameter, moulded and formed of a peculiar bronze material which is supposed to be able to resist the action of salt water for a thousand years. Inside this case or globe, and hermetically sealed, is the simple mechanism which performs the functions of an office and two operators at the bottom of the sea in mid-ocean, without the aid of human intervention at that point. By the use of this instrument a cable of any given length, say two thousand miles, may be divided in the centre into two circuits or lengths of one thousand miles each, and thereby a working speed can be had, according to an established electrical law, four times greater than on a circuit or cable of two thousand miles; consequently one cable connected by this submarine repeater would be equal for effective work to any four of the present Atlantic cables. To put the proposition in another way, if one of the present cables is worth 5,000,000 dollars, then one cable of the same length connected by this submarine repeater would be worth 20,000,000 dollars, and there would be property at risk and on interest at the bottom of the ocean costing only 5,000,000 dollars instead of 20,000,000 dollars, so that the net receipts would be divided on 5,000,000 dollars in shares instead of on 20,000,000 dollars. Another important fact is that this submarine repeater is to make it practicable to operate a cable twice the length of any present cable, say 5,000 miles in length, with the same speed as present cables are worked. Thus a cable might be worked between San Francisco and China, where the distance between landing points are too great for practical or paying speed by the present system of cable working. The relays transmitting and receiving are to be used in connection with the submarine repeater. They are on an entirely new principle, the discovery of the inventor, by which they work equally well in any position, and with extreme delicacy.

The type printers and the instruments for working the automatic system on cables are models of delicate mechanism. The system of working the automatic instruments is most simple, more so than the Wheatstone or the so-called "Fast Rapid," and there seems to be no doubt that they cannot fail to have an effect upon land telegraphy in the future, as well as on cable telegraphy. The number of words that can be sent over a cable by these new instruments is limited only by the number of impulses that can be sent through the cable; and, in the case of this new company's cable, it will be over 4,000 impulses per minute. The model cable upon which the tests of this apparatus have been made, now set up in the Equitable building, represents 2,250 marine miles of the ordinary Atlantic cable. It represents resistance and static effects of cables, and is worked by the interposition at either end of condensers, one termed the "speaking condenser" and the other the "receiving condenser," so that the dynamic current from the batteries does not go out on the cables, but a static charge from the condensers operates the repeater at mid-ocean, and so on. This system of increasing the capacity of the submarine cable and the several instruments for vastly improving its workings are the discovery and invention of Mr. S. F. Van Choate. He is an electrician of high accomplishments and master of his art. He has invented before this instruments of practical value and utility which are now in use in telegraphy. His remarkable ability as an inventor is well known both in America and in Europe.

In January last Dr. Paget Higgs, associate member of the Institution of Civil Engineers of London, and late electrician-in-charge of the Direct United States Cable Company's final expedition, was called here by the American Cable Company to superintend the electrical construction of the various apparatus described above. He purchased in England the necessary testing appliances. The coils and condenser were specially tested and compared with well-known standards, and thus accurate bases for determining the value of the new apparatus were afforded. Since February he has been engaged here in the work of testing. In a preliminary report, under date of September 14, he says: "In this improved system of signalling, the cable is divided into two lengths or sections by the submarine repeater, each section acting practically as 'local' circuit to the section first receiving the current. By this arrangement the length in a single circuit being reduced one-half the speed of signalling is, according to known laws, increased four-fold. Besides this advantage there is a further advantage gained from the printing system adopted by which instead of several impulses being required for a single letter only one impulse is required for each letter, increasing the carrying capacity of the cable about five times. By combination of these advantages it is found that a carrying capacity is obtained on the same cable twenty-fold that of the present galvanometer system." Among others who have examined these inventions are Professor John Trowbridge of Harvard University, Professor Benjamin Silliman of Yale College, Professor A. E. Dolbear of Tufts College, Professor Moses G. Farmer of Newport, R.I., and Professor George F. Barker of the University of Pennsylvania. Professor Trowbridge writes: "This is to certify that I have examined Mr. Van Choate's repeater and his very ingenious apparatus for submarine telegraphy. I think that the repeater will successfully work on submarine or land lines, and I regard the arrangement for systematically trimming electrical impulses through a submarine cable as the beginning of a new era in submarine telegraphy." Professor Silliman writes:—"The mode of halving the cable resistance in mid-ocean by this repeater is simple and most ingenious. The whole arrangement of apparatus appears to me to open a new era in ocean telegraphy in favour of rapidity, certainty and economy." Professor Farmer

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writes :—"I have examined carefully the submarine repeater of Mr. Van Choate, and am able to state that it will successfully repeat on either land lines or ocean cables." Professor Dolbear substantiates Professor Farmer's testimony. And Professor Barker writes :—"The commercial importance of the increased speed of transmission, which there is every reason to believe he (Mr. Van Choate) will gain by the use of his mid-ocean repeater and his sensitive shore relays, especially in connection with his novel and excellent printing system, it would not be easy to over-estimate. I am confident that, by these admirable devices, he has practically solved the problem of working ocean cables by means of relays."

The American Cable Company was formed in New York some time ago, under the general laws of that State, for the purpose of introducing and carrying out these improvements, and it is composed of prominent capitalists in the United States and in Europe. It has been quietly and steadily progressing towards the end of its designs. Its purpose is to lay some six thousand miles of superior cables, connecting New York city directly with five or six European countries. It is an American enterprise, and the inventions under its control are American work. The success of this enterprise will be another American triumph in the field of telegraphy and in electrical science.—*Boston Daily Advertiser*, Sept. 25.

JOSEPH HENRY.

At the recent meeting of the American Association for the Advancement of Science Professor A. M. Mayer delivered an eulogy on the late Joseph Henry which he had prepared. Professor Mayer said :—

Henry began his electrical researches at the age of twenty-eight in the year 1827, while he was Professor of Mathematics and Natural Philosophy in the Albany Academy. At these he continuously worked till 1832, when, at the age of thirty-three, he moved to Princeton College. After a year's break in his work, caused by the preparation of his course of lectures for the college, he is again at original research, and continues his contributions to electrical discoveries till 1842. Thus, during fourteen years, between the ages of twenty-eight and forty-three, he was a constant and fertile worker.

As with many other men of originality, Henry's first essays were in the direction of improving the means of illustrating well-established scientific facts and principles. His first paper of October, 1827, is interesting because it was his first. In it he improves on the usual apparatus which had been used by Ampère and others to show electro-dynamic actions, by employing several turns of insulated wire, instead of one, as had previously been the practice. Thus, for example, to show the directive action of the earth's magnetism on a freely-moving closed circuit, Henry covered copper wire with silk, and then made out of it a ring about twenty inches in diameter, formed of several turns of the wire. The extremities of this wire were soldered to zinc and copper plates. The coil was then suspended by silk filaments. On plunging the metal plates into a glass of dilute acid the ring rotated around its point of suspension till its plane took a permanent position at right angles to the magnetic meridian. By a similar arrangement of two concentric coils, one suspended within the other, he neatly showed the mutual actions of voltaic currents flowing in the same or opposite directions, which facts are the foundations of Ampère's celebrated law. We now reach a period when Henry appears as a discoverer, and truly one of no mean order. As I remember his narration to me in the year 1859, it was as follows :—He said that one evening he was sitting in his study in Albany with a friend, when, after a few moments of reverie, he arose and exclaimed, "To-morrow I shall make a capital experiment!" For several months he had been brooding over Ampère's electro-dynamic theory of magnetism, and he was then deeply-interested in the phenomena of the development of magnetism in soft iron, as shown in the experiments of Arago and Sturgeon. At the moment he had arisen from his chair it had occurred to him that the requirements of the theory of Ampère were not fulfilled in the electro-magnets of Arago and of Sturgeon, but that he could get those conditions which the theory required by covering the developing wire with a non-conductor, like silk, and then wrapping it closely around the soft iron bar in several layers; for the successive layers of wire coiling first in one direction and then in the other would tend to produce a resultant action of the current at right angles to the axis of the bar; and furthermore, the great number of convolutions thus obtained would act on a greater number of molecules of the bar, and therefore exalt its magnetism. "When this conception," said Henry, "came into my brain, I was so pleased with it that I could not help rising to my feet and giving it my hearty approbation." Henry did go to work next day, and to his great delight and encouragement discoveries of the highest interest and importance revealed themselves to him week after week. When he had finished his newly conceived magnet he found that it supported several times more weight than did Sturgeon's magnet of equal size and weight. This was his first original discovery.

I will now give, as far as possible, Henry's own words in narrating the subsequent investigations of these very interesting phenomena :—"The maximum effect, however, with this arrangement and a single battery was not yet obtained. After a certain length of wire had been coiled upon the iron the power diminished with a further increase of the number of turns. This was due to the increased resistance which the larger wire offered to the conduction of electricity. Two methods of improvement, therefore, suggested themselves. The first consisted, not in increasing the length of coil, but in using a number of separate coils on the same piece of iron. By this arrangement the resistance to the conduction of the electricity was diminished and a greater quantity made to circulate around the iron from the same battery. The second method of producing a similar result consisted in increasing the number of elements of the battery, or, in other words, the projectile force of the electricity, which enabled it to pass through an increased number of turns of wire, and thus, by increasing the length of the wire, to develop the maximum power of the iron. To test these principles on a larger scale an experimental magnet was constructed. In this a number of compound helices were placed on the same bar, their ends left projecting, and so numbered that they could be all united into one long helix, or variously combined in sets of lesser length. From a series of experiments with this and other magnets it was proved that, in order to produce the greatest amount of magnetism from a battery of a single cup, a number of helices is required; but when a compound battery is used, then one long wire must be employed, making many turns around the iron, the length of wire and consequently the number of turns being commensurate with the projectile power of the battery. In describing the results of my experiments the terms *intensity* and *quantity* magnets were introduced to avoid circumlocution, and were intended to be used merely in a technical sense. By the intensity magnet I designated a piece of soft iron so surrounded with wire that its magnetic power could be called into operation by an intensity battery; and by a quantity magnet a piece of iron so surrounded by a number of separate coils that its magnetism could be fully developed by a quantity battery. "I was," said Henry, "the first to point out this connection of the two kinds of the battery with the two forms of the magnet, in my paper in *Silliman's Journal*, January, 1831, and clearly to state that when magnetism was to be developed by means of a compound battery one large coil was to be employed, and when the maximum effect was to be produced by a single battery a number of strands were to be used."

We will now return to Henry's study of the properties of his intensity magnet. This magnet was formed of a piece of iron one-fourth of an inch in diameter, bent in the U form, and wound with eight feet of insulated wire. His batteries were two—one formed of a single element with a zinc plate four inches by seven, surrounded by copper and immersed in dilute acid, the other a Cruikshank battery or trough with twenty-five double plates. The plates of this battery were joined in series, and altogether had exactly the same surface of zinc as that in the single-cell battery. The magnet was now connected directly to the single cell. The magnet held up seventy-two ounces. Then five hundred and thirty feet of number 18 copper wire led the current from the cell to the magnet; it now supported only two ounces. Five hundred and thirty feet more of the wire were introduced into the circuit, and then the magnet held but one ounce. In these facts Henry faced the same results as confronted Barlow five years before, and caused Barlow then to say: "In a very early stage of electro-magnetic experiments it had been suggested [by Laplace, Ampère, and others] that an instantaneous telegraph might be established by means of conducting wires and compasses, but I found such a sensible diminution with only two hundred feet of wire, as at once to convince me of the impracticability of the scheme;" and such, at that day, seemed to be the common opinion of men of science. But this opinion is presently to be shown by Henry to be ill-founded, by reason of the ignorance of the relations which have of necessity to exist between the kind of battery and the kind of magnet in order to produce electro-magnetic action at a distance—relations which Henry was the first to discover. This accomplishment justly entitles him to be regarded as a man of genius and a discoverer of no mean order. This discovery will always remain the one important fact that was to be known, to be understood, and to be applied, before it was possible to have constructed any form of electro-magnetic telegraph. Let us see how Henry made this discovery.

After ending the experiments with the one-cell battery and reaching results which seemed to confirm the opinion of Barlow as to the "impracticability of the scheme" of an electro-magnetic telegraph, Henry attached his magnet to the second battery formed of twenty-five cells, arranged in series. The current from this battery was sent to the magnet through 1,060 feet of the same wire as had been used in the experiments with the first battery of one cell. The magnet now lifted eight ounces. It had held up only one ounce, when with the same length of interposed wire the battery of one cell was used. He now attached his electro-magnet directly to the poles of the 25-cell battery, when, to his astonishment, it only held seven ounces. The same magnet it will be remembered, when attached to the one-cell battery, supported seventy-two ounces. Here were facts of the highest significance, and Henry was not slow to seize them in all their bearings. Referring to these experiments, he said in 1857 :—"These steps in the advance of electro-magnetism, though small, were such as to interest and astonish the scientific word. These developments were considered at the time of much importance in a scientific point of view, and they subsequently furnished the means by which magneto-electricity, the phenomena of diamagnetism and the magnetic effects in polarised light were discovered. They gave rise to the various forms of electro-magnetic machines which have exercised the ingenuity of inventors in every part of the world, and were of immediate applicability in the introduction of the magnet to telegraphic purposes. Neither the electro-magnet of Sturgeon nor any electro-magnet ever made previous to my investigations was applicable to transmitting power to a distance."

Not satisfied with the mere statement that his discovery was "directly applicable to Mr. Barlow's project of forming an electro-magnetic telegraph," he actually constructed one, some time during the year 1831, around one of the upper rooms of the Albany Academy. It was more than a mile in length, and made signals by sounding a bell. This was the first electro-magnetic telegraph which had worked through so great a length of wire. It was the first "sounding" electro-magnetic telegraph. The relative parts played by Henry and Morse are described in Henry's "Statement" published by the Smithsonian in 1857. "*The principles*," says Henry, "*I had developed were applied by Dr. Gale to render Morse's machine effective at a distance.*" This statement seems to be as direct, as clear, as truthful, and as comprehensive as one can desire. I will take the liberty of remarking that had Henry taken out a patent in which he claimed as his invention an electro-magnet formed of two or more layers of insulated wire, Morse's patent would not have been so valuable. Remember, I speak not of the merit of the invention, but of the merit of the patent; for the invention, so far as Morse is concerned, would have remained the same, because one essential part of a Morse telegraph is Henry's intensity magnet, and certainly Morse never invented that.

(TO BE CONTINUED).

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THE ELECTRICIAN.

TO CORRESPONDENTS.

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CONTENTS.

Slip ——— ——— ———

voyage of the Great Eastern there is a lingering fascination about a cable expedition.

A popular lecture on the telegraph should begin by a brief prelude on the extraordinary development of telegraphy in our times, and then sketch the early history of the subject in a broad and salient manner. It should next describe the making, building, and working of a land-line and a submarine cable. These processes should be illustrated by proper diagrams, and the working especially should be shown by actual apparatus in operation. The maintenance of land-lines should then be touched upon, and the repairing of submarine cables (a puzzling and exceedingly interesting part of the subject to those unversed) dwelt upon more fully. Next some very diverting remarks can be made on the haps and mishaps of telegraph lines, such as the "earths" caused by monkeys, birds' nests, savages, and other depredators in aerial lines, and the faults due to the attacks of fish, ensnared whales, earthquakes, &c., in the case of cables. Finally, the public and international importance of telegraphs would make a very effective close.

One of the best lectures we ever heard on the telegraph was that recently delivered by Mr. Andrew Jamieson (formerly of the Eastern Telegraph Service) in his new capacity of Principal of the Mechanics Institution at Glasgow. As his inaugural lecture, the new Principal chose a subject which was not only familiar to him and on which he was especially well qualified to speak but one which was likely to interest all, namely, the "Making and Laying of Submarine Cables." The selection was amply justified by the hearty and prolonged applause which greeted him at the close and the gratifying compliment of Sir James Watson, one of the directors of the institution. Mr. Jamieson glanced, in the first place, at the commercial and political importance of submarine cables, and then reviewed the systems of the different telegraph companies of the world. He particularly explained, by means of a large chart, the extensive and well-managed systems of the Eastern and Eastern Extension Companies, with which he had been connected, and pointed out the wise policy of their chief directors, Mr. John Pender and Sir James Anderson, in providing duplicate and triplicate routes for greater security of communication. He then touched on the Brazilian lines, the West Coast of South America cables, and showed that a cable between Vancouver Island or San Francisco to Japan was only needed to complete the electric girdle of the world. After this preamble he explained the processes of making, laying, and repairing of a cable, together with the construction of a cable ship, in a clear, succinct, and very interesting manner. He was amply provided with excellent diagrams and apparatus, including the latest forms of grapnel and sounding appliances; for example, Sir William Thomson's new machine for taking flying soundings by pianoforte wire, and the "nipper lead" of Mr. Lucas. Altogether, Mr. Jamieson's lecture was admirably done, and showed him to be possessed of one of the first requisites of a public teacher, namely, the art of exposition.

CORRESPONDENCE.

THE GAS AND ELECTRIC LIGHT EXHIBITION AT GLASGOW.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Your correspondent describing the above is hard on us exhibitors of electric light apparatus, saying that we are always behindhand, and, when we do show, do not show at our best for some time. I think if you consider that we have to supply the entire plant for the production of the electric light, *i.e.*, engine, dynamo-electric machines, cables, connections, lamps and lanterns, whereas our gas competitors have the very excellent gas supplied to them from the mains laid on ready to their stands, and have only to hang up and attach a few lanterns and burners to make a very effective display you will not have to go far for the explanation. If each exhibitor of gas apparatus had to fit up a temporary gasworks for the supply of gas to the burners shown on his stand, I do not think that the gas side of the exhibition would be quite so brilliant as at present, and I think it is just possible that there might be a few hitches and extinctions of the light even among the gas exhibitors during the early days of the exhibition.

Speaking for myself, all my apparatus has been ready for showing the light for some days, but I lack an engine to drive the dynamo-electric machines. This has arisen from an unfortunate misunderstanding regarding the supply of the steam power, which has made my engine late in arriving. I have no doubt others are in the same position.

I beg to correct your correspondent in some few mistakes he has fallen into regarding the exhibitors.

The British Electric Light Company are not exhibiting at all. Messrs. L. Clark, Muirhead and Co. are exhibiting the Lontin light, the Anglo-American Company are to exhibit the Brush system, Strode and Company show the M'Kenzie lamp, I show my own apparatus in my own name. I have not heard who is to show Brockie's lamp. In a few days I believe that there will be a fine display, and your correspondent will have nothing to complain of. This exhibition has taken place at the very busiest season of the year for us electric light engineers, and it is not to be wondered at that many good firms could not afford to send skilled operatives to remain with their stands for a month.—Yours, &c.,

R. E. CROMPTON.

Mansion House Buildings, London, Oct. 9.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. Johnstone, in your last issue, credits me with a great deal more knowledge than I either possess or hope to possess for many years to come.

If I knew in which direction any current of electricity flows I should have no need to ask "What is electricity?" I do not even know whether the flow has a direction at all.

When one end of a wire is connected to a source of electricity, and negative electricity appears at its other end, it is a common convention to say that "Negative electricity has travelled along the wire *from* the source."

If, Sir, Mr. Johnstone likes to deposit his £50 in your hands, with a request to you to hand it over to me if you are satisfied with my proof, I shall be most happy to give him and you "ocular proof" that a current of negative electricity flows from the rubbers to the earth, and further, if I should be so fortunate as not only to satisfy you, but to cause Mr. Johnstone to reverse his opinion, then if he cares to offer a second £50 to back his new views, I shall have great pleasure in showing him a second experiment which will clearly prove that so far from there being a current of negative electricity from the rubbers to the ground there is a current of positive from the ground to the rubber; and I will go on proving the two views alternately as long as anyone cares to stake money on either side of the question.—Yours, &c,

J. E. H. GORDON.

Pixholme, Dorking, Oct. 12, 1880.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED.)

Report of the Directors to the fourteenth half-yearly general meeting, to be held at the Cannon-street Hotel, on the 22nd October, 1880. The directors submit the annexed accounts and balance sheet for the half year ended 30th June, 1880. The revenue for this period amounted to £78,036 18s. 6d.; the working expenses to £11,707 10s. 10d., leaving a balance of £66,329 7s. 8d.; to this is added £34,221 12s. 11d., the undivided profits to 31st December last, making a total of £100,551 0s. 7d. After deducting income-tax, £947 2s. 8d., there remains a balance of £99,603 17s. 11d. A third interim dividend, amounting to £16,250, has been distributed since the last accounts were presented, leaving the sum of £83,353 17s. 11d. for appropriation. The directors now recommend the declaration of a final dividend of 2s. 6d. per share, making a total dividend of 5 per cent. for the year ending 30th June, 1880, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £29,250, being a distribution in the aggregate of 6 per cent. for the past year, leaving a balance of £54,103 17s. 11d., of which amount £50,000 has been placed to the reserve fund, increasing that fund to £285,245 19s. 2d., and £4,103 17s. 11d. carried forward. The company's cables continue in good working order.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

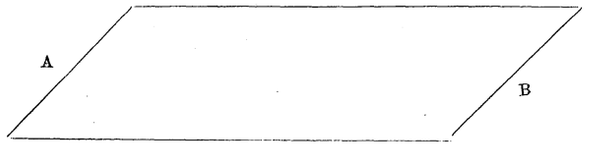
BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 245.)

LECTURE IV.—DELIVERED FEBRUARY 23, 1880.

As regards uses of caoutchouc bearing on every day life, very much might be said, but the time is, unfortunately, rapidly advancing. The making of an umbrella ring is a very ingenious and curious operation, which I will proceed to illustrate to you. A strip of the softened and mixed sheet rubber is cut off obliquely at each end as you see me now cut it (Fig. 27), and after it has been rubbed over with rubber solution to render it adhesive, the

FIG. 27.



obliquely cut ends (A and B) are brought in contact, so that a short tube is formed. This being next placed on a mandril, one end of the short tube is turned over on itself continuously, so as to convert the tube into a round-rimmed ring. In practice the operation is conducted much more rapidly than I have done it. The rings are laid in French chalk and cured by a steam heat; but very often these articles, instead of being made of mixed rubber, are manufactured from cut sheet.

The squeegee is an instrument of American origin, and consists of a stoutish strip of vulcanised rubber mounted scraper fashion in a piece of wood. The scraper-like edge of the india rubber slides with very great ease over any wet surface, forcing before it any dirt or foreign matter in a manner which is surprisingly complete. No doubt you have all seen the squeegee made use of for cleansing the roads and pavements in rainy weather. The squeegee forms an admirable window cleaner, as I can illustrate to you by applying one to a piece of dirty glass; but it must always be used in conjunction with an abundant supply of water, as the friction between india rubber and dry glass is very great. Considerable use is made of the squeegee in several of the photo-mechanical printing processes, which I had the pleasure of illustrating to you two years ago, as some of you will doubtless remember.

Door mats of vulcanised rubber are now being extensively made use of. The mixture employed for their manufacture is generally of a very low quality; old vulcanised caoutchouc, fibrous materials, and mineral matters, such as whiting, being freely added; about 20 per cent. of a low quality of new rubber, such as African tongue, being often considered sufficient. The material having been calendered to the requisite thickness, a very partial and imperfect curing is generally effected at this stage, the sheets being exposed to a moderate heat between metal plates, these being often corrugated. After this the patterns of the mats are cut out by means of punches and cutters, the device having been stencilled on the sheet by means of French chalk dusted through a perforated metal plate. The mats are next laid in French chalk, and cured by steam. The punchings are worked over again, the slight preliminary curing or setting being insufficient to offer any notable hindrance to this course.

A very excellent method of manufacturing mats, but one not adopted to any great extent in this country, is to mould them in cast-iron moulds, and then to cure by the dry heat of the steam press (Fig. 26). Other methods, such as building up the maps out of strips, are also occasionally adopted. Nearly related to door-mats are door-stops or buffers, articles of considerable utility in preventing damage to houses by a continual banging of the doors. Small blocks of rubber are often set in the door frames of railway carriages to receive and deaden the first effects of the blow resulting from a rapid shutting of the doors.

In the manufacture of toys, the applications of caoutchouc are very numerous, and often exceedingly ingenious. Here is a small air ball, or balloon, to which is attached a wooden tube, provided with an india rubber strip, acting as a reed. The reed does not vibrate while the balloon is being distended; and by closing the tube by means of one finger, the air may be retained in the balloon; but on removing the finger, out it goes with a rush, causing an unearthly screak calculated to delight the infant mind. Hollow playing balls are made of four segments of calendered sheet, put together balloon fashion. Here is one at this stage; it certainly does not look much like a ball, but more like a withered pear, which has resided for some time in a square tube rather too small for it. The next step is to enclose the incipient ball in a hollow spherical mould, best made of slate, and to expose it to a vulcanising heat. The air inside the india rubber now expands, forcing the material into close contact with the mould, and when the vulcanisation is complete, a perfect counterpart of the interior of the mould is the result. As the included air contracts, the ball, to some extent, collapses, as you see in the case of these samples; but by cutting a small circular hole in one of the balls, it, as you see, can be made to regain its spherical shape immediately. In some cases it is considered better to tightly distend the cured balls by compressed air; and this may be effected by attaching a small lump of unmixed rubber to the interior of the ball, before it is made up, and this lump undergoes no change in the curing process. When the cured ball is taken from the mould, a sharp-pointed or sting-like tube is passed through at the point where the lump is situated, and air is forced in through this tube. On withdrawing the tube, the hole closes, and the freshly divided surface of the unvulcanised rubber unites again.

I do not think I told you anything about the so-called india rubber sponge, or froth-like rubber, which may be used for toilet purposes, as padding, or as rubbers for cleaning shoes or various other articles. It is made by incorporating with the rubber certain substances which will give off vapour or gas during the process of curing. Among these may be mentioned damp sawdust, crystallised alum, and carbonate of ammonia. The sponge is vulcanised in moulds, which it fills during the act of expanding. An ingenious application of the sponge rubber is made in the manufacture of a certain kind of playing ball. Some of the sponge rubber composition—which, by-the-bye, may be compounded as follows:—

20	parts washed rubber of low quality.
10	parts red lead or other pigment.
50	parts old vulcanised rubber in a finely divided state.
8	parts sulphur.
6	parts damp sawdust finely ground.
6	parts oxydised linseed oil.
100	

—is wrapped round a small ball of wood, and the whole is then placed in a spherical mould somewhat larger than the wooden core and its rubber envelope. The heat necessary for curing being now applied, the rubber swells and fills the mould. On taking one of these sponge balls into the hand, its softness would naturally cause one to think it was made of a fine quality of rubber, and to wonder at it being sold at the low price charged; but, on cutting it in two, the mystery is explained; a wooden core and a coating of very low quality sponge rubber being its factors. Very many hollow articles are made in moulds, in the same manner as the hollow balls; not only toys, such as dolls, being produced in this way, but also such goods as injection bottles and analogous articles; the principle of utilising the expansive force of air for forcing the rubber up to the sides of the mould being of widespread application in the rubber industry. Tin or cast iron moulds are often employed, and, in some cases, a compression of air into the finished article is rendered unnecessary by adopting the expedient of forcing air into the article after it is placed in the mould, but before curing; the soft mixed rubber closing immediately on the minute hole which is necessary for this purpose.

The use of india rubber for cleaning paper and erasing pencil marks is a well-known application of the material, but its usefulness in this respect can be very much increased by incorporating certain gritty materials with it, such as pumice or finely-divided silica. Messrs. Wolff and Sons exhibit a collection of rubber specially prepared for these uses; and they have adopted the plan of mounting the rubber, squeegee fashion, in wooden blocks. By this arrangement contact between the hand and the rubber is avoided. Some people let their erasing rubber get very dirty, and then express surprise that it fails to clean paper.

Very pretty casts or mouldings of phototypic reliefs may be made in vulcanised india rubber; and I will next illustrate to you the method of making such casts, at least as far as the manipulation of the caoutchouc is concerned. Here is an ordinary photographic negative, and this is a type metal cast or mould, produced by photographic agencies from the negative. Those portions of the negative which are opaque correspond to relief in the type metal mould, while the depressions of the mould correspond with the transparent portions of the negative.

The first step is to very slightly oil the mould, after which blacklead is applied to the surface, and the excess is polished off by means of a soft brush. A sheet of mixed rubber, previously

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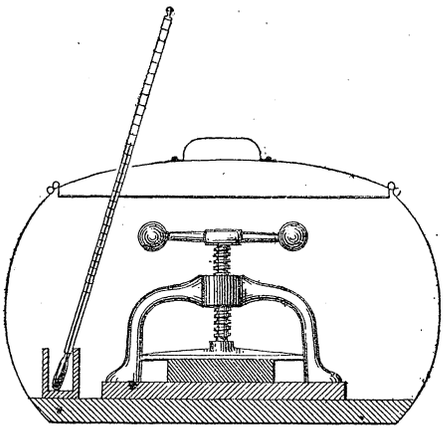
softened by heat, is next applied to the prepared surface of the mould, and curing is effected by means of the small hot press into which the mould and rubber are now placed. A hot press of the kind now before you (Fig. 28) is very convenient for

FIG. 28.



HOT-PRESS FOR THE VULCANISATION OF INDIA RUBBER CASTS OR STEREOTYPES.

the curing of small flat articles and casts. It consists of a cast-iron fish kettle, upon the bottom of which rests a slab of type metal an inch thick. Inside the kettle is placed a small press, like a copying press in miniature. By the side of the press stands a small iron cup, containing glycerine, and in this fluid is immersed the bulb of a thermometer, the stem of which projects through a hole in the cover of the kettle. By means of a small gas stove, heat can be applied to the apparatus, and it is easy to so adjust the gas supply, that the thermometer shall indicate a tolerably constant temperature of, say 140° or 150° Centigrade. Most qualities of mixed rubber will become fairly well cured by being heated under these circumstances for half to one hour, and any tendency towards adhesion to the mould is obviated by the preparation with oil and blacklead, as described.

The apparatus is extremely well adapted for curing the india rubber stereotypes or stamps, which are now so extensively used for endorsement and other purposes. To make these stereotypes, a reverse or mould is made from the types, this being taken in plaster of Paris, or better still, in metal. When plaster is employed it is well to harden it, by saturating it with an alcoholic solution of shellac, and again drying. The soft mixed rubber is then forced into the mould, as you now see me doing it, after which the curing may be effected in the hot press (Fig. 28).

Mr. John Leighton introduced rubber stereotypes about eighteen years ago, and since that time their use has become very general for a great variety of purposes. Mr. Leighton has very kindly sent, for your inspection, an interesting collection of specimens, illustrative of the manifold uses to which india rubber stereotypes can be applied. Glass and other hard bodies may be printed on with the greatest ease; and by dusting the impression with a vitrifiable colour, the impressions may be burnt in. Here are some of Mr. Leighton's specimens, illustrating what was done in this direction as far back as ten years ago. Again, the rubber stamps lend themselves admirably to the production of impressions on curved or cylindrical bodies; this being illustrated by rocket cases, printed under Mr. Leighton's directions twelve years since. Much ingenuity is displayed in the construction of the various self-inking pocket and pencil stamps. These are before you, and you can examine them for yourselves.

I, for one, believe that the time will come when newspapers and books will be largely printed from india rubber stereotypes. They can be easily and rapidly made, and I have cured rubber very successfully in the usual paper or "flong" moulds, faced with tin or lead foil, this latter being laid first on the type. The steam press (Fig. 26) might be employed for curing a rubber stereotype much larger than anything yet attempted in metal; and by employing a suitable rubber composition, it is not unlikely that a thorough curing might be effected in as short a time as ten or fifteen minutes. The power required to drive printing machines, working with rubber stereotypes, would be comparatively small, while impressions quite as sharp as those from metal ought to be secured. One advantage of the rubber stereotypes would be the ease with which they can be adapted to cylinders of any curvature. As regards ink for stereotypes, a few words may be said. A fatty ink naturally injures the rubber; at any rate, if it is not very carefully removed after use; but an ink having glycerine as a basis answers extremely well, and may, as the specimens on the table prove, be left in contact with the stamps without in any way injuring them.

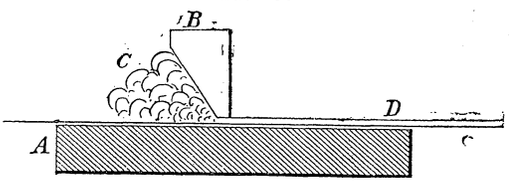
Inking rollers made of india rubber have been occasionally made use of from time to time for many years, but owing to inexperience in their manufacture and use, the results have been, until quite recently, far from satisfactory. You will probably remember that, when lecturing here on photo-mechanical printing, I showed you how a printing roller could be made with a body of the usual soft gelatine composition, and a face of red vulcanised rubber, smoothed by means of glass paper. This circumstance brought to my knowledge the fact that Mr. Robert Lanham had been very successfully labouring in the improvement of india rubber rollers. By the kindness of Mr. Lanham, I was enabled to show you some of his rollers at the lecture immediately following the occasion when I showed you my own. During the two years which have elapsed since that time, Mr. Lanham has still further developed the manufacture of rubber rollers for printing purposes, and I am indebted to him for the opportunity of now showing you the very fine collection of these articles which stand over yonder. Mr. Lanham makes his rollers from red rubber, which is, of necessity, very thoroughly cured, in order to enable it to withstand the action of fatty inks; and after the rollers have been turned true by means of self-acting lathes, a fine surface is given to the rubber by means of glass paper. In order to give his rollers the softness which is necessary in some cases, Mr. Lanham now introduces a series of perforations parallel to the axis. For lithographic printing, these rollers have very considerable advantages over the usual leather roller, and some excellent samples of work done with them hang on the walls.

India rubber does many services in connection with the art of printing, some of these being of very great interest; but it is impossible to go farther into the matter this evening.

Waterproof goods, consisting of a thin layer of rubber spread on a textile fabric, are very extensively made use of for the fabrication of overcoats, and other waterproof garments. In the manufacture of these goods the first step is to prepare a dough or paste suitable for spreading on the material. If the vulcanisation of the coating is to be effected by means of steam heat, as in the case of cotton or linen goods, a composition of the following nature may be spread on the fabric:—20 lbs. washed rubber, 20 lbs. zinc white, 5 lbs. sulphur, 6 or 8 lbs. of solvent naphtha. When, on the other hand, the curing is to be performed by the cold process, the sulphur may be omitted. After the rubber has been softened by the absorption of the solvent naphtha, the materials are thoroughly incorporated by means of a mixing or kneading machine.

A very good illustration of the action of a spreading machine is afforded by the model which is now before you. It (Fig. 29) consists of a baseboard, A, over which is supported a rule-like

FIG. 29.



MODEL ILLUSTRATIVE OF THE ACTION OF THE SPREADING MACHINE.

bar, B. The material to be coated is placed under the bar, a quantity of the paste or dough is piled up in front of the bar, at C, and the cloth is drawn forward, towards D, so that the rule or bar cuts off an even layer of the soft mixture. In actual practice the fabric, after having received a coating of the composition, is passed over a heated steam chest in order to dry off the solvent naphtha. In the case of ordinary goods about six coats are given—three in each direction. Each coat may be estimated as being about one-hundredth of an inch in thickness.

The method of applying the mixture of carbon disulphide and chloride of sulphur used for effecting the cold vulcanisation of the india rubber coating when spread on goods which would be injured by high-pressure steam is of some interest. The coated fabric (C, Fig. 30) passes round a roller (D), coated side being outwards, and at the point E it is brought into contact with a more rapidly revolving slate roller, A, which dips in the vulcanising solution, this being contained in a trough, B. The solution, which consists of 1 part of chloride of sulphur and 40 parts of carbon disulphide, is led upwards by the roller A, towards the point E, where it forms a kind of accumulation or wave. All excess drains back as the fabric travels towards the point C.

Double-texture fabrics can be produced by employing similar apparatus, but double; and the two textures, which are vul-

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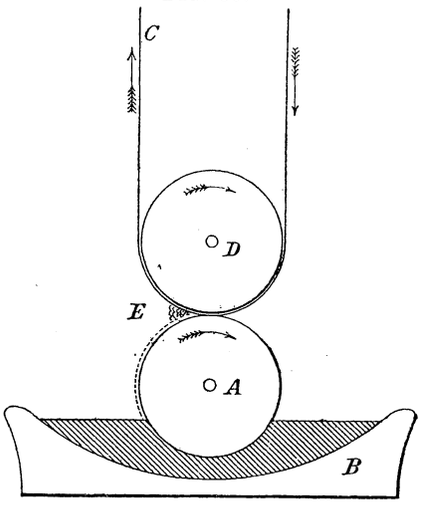
canised simultaneously, are brought into contact immediately after the curing solution has acted on them. Under these circumstances they adhere, but when made up into coats, &c., these double textures can be separated at the edges by the application of benzole; this being a matter of great convenience in joining the various parts of a garment together.

Spread goods are often varnished by the application of a dilute ammoniacal solution of shellac, the surface of the goods being generally prepared for the reception of this by the application of water, or of water containing a trace of an alkali, soap, or ox gall, either of which facilitates the adhesion of the lac varnish.

A large number of specimens of spread goods are on the table, these having been supplied by Messrs. William Currie and Co., of Edinburgh, the Silvertown Company, Messrs. Cow and Co., Messrs. Anderson, Abbott, and Anderson, and others.

FIG. 30.



COLD CURING OF SPREAD GOODS.

Spread sheets, already referred to several times, are made by spreading a mixture of sulphur (or other vulcanising material) and softened rubber on clothes previously charged with a mixture of paste, treacle, and glue. The required thickness having been built up, vulcanisation is effected by means of steam, and the prepared cloth, being softened by the action of water, can be easily removed from the sheet of rubber. Sometimes the required thickness of spread sheets is built up on two separate pieces of the prepared cloth, and the adhesive surfaces of the rubber being placed in contact, they unite, after which vulcanisation is effected in the usual way, and the cloths are removed.

Spread sheets, prepared by the latter method, show the marking of the cloth on both sides, while those prepared by the first method are smooth on one side. As a general rule, spread sheets are more perfectly elastic than calendered sheets, as the rubber undergoes less mechanical tearing or deterioration. They are generally preferred for cutting into threads.

Mr. Sexton, the representative of the National India Rubber Company, of France, has kindly lent me a well-assorted set of specimens, illustrating the use of caoutchouc in the manufacture of boots and overshoes; this firm turning out over two millions of pairs yearly. Articles of this kind are generally made out of a mixed rubber, which is calendered on to woven or knitted fabrics, these having been previously frictioned. After the articles have been made up and varnished, they are cured in stoves or ovens, heated from 130° to 150° Centigrade.

Several processes have been proposed for the desulphurisation of old vulcanised caoutchouc, but the success attending endeavours of this kind has been very limited. The incorporation of old rubber with new has been referred to already. The use of old rubber in making the admirable floor-cloth known as kamptulicon, is a very useful application of it.

Kamptulicon consists of old rubber and cork, both materials being brought into a state of fine division, after which they are incorporated by heated rollers, and then rolled out into sheets. You need not seek far for a specimen of this material, as the floor of this room is covered with it. The Britannia Rubber and Kamptulicon Company have lent me the figured and patterned specimens which are attached to the wall, and also other articles, which illustrate the various uses of this material. Knife-cleaning boards are often covered with it; and when made up into sheets, two inches thick, it is extensively employed as a means of deadening the effects of concussion. These thick sheets are particularly adapted for covering the floors of riding schools, or for lining cells in which violent lunatics are confined.

(TO BE CONTINUED.)

GLASGOW MECHANICS' INSTITUTION.

Mr. Andrew Jamieson, C.E., Principal of the Glasgow Mechanics' Institution, recently delivered the opening lecture to the electricity, magnetism, and natural philosophy classes in connection with the institution, his subject being "The working and repairing of submarine cables." Mr. Jamieson, at the outset, commented on the difficulty which electricians found in the early days of submarine telegraphy of telegraphing through long lengths of submarine cable, owing to the retarding force of induction. This opposing force always presented itself when an electric current was passed through a submarine cable, and no means had yet presented itself to electricians of annihilating it. Sir William Thomson had, however, by means of his clever invention of the mirror galvanometer, placed in their hands an instrument of a delicate nature, which enabled them to work with ease through much greater lengths and at greater speed than any other yet devised. Mr. Jamieson then described the instrument in detail, and showed how it worked, pointing out its defects, and explaining the working of Sir William Thomson's later invention, the "Siphon Recorder." He exhibited a beautiful instrument of this kind, made by Mr. White, of Sauchiehall-street, which was about to be sent to Bombay to work the Bombay-Aden section of the Eastern Telegraph Company's system. The lecturer also presented to his audience various slips of the curious telegraphic writing which this instrument produces, explaining how it was read by telegraphists. Mr. Jamieson afterwards showed a telephone lent for the evening by Mr. Graham, Sauchiehall-street, and explained how it was that it was not as yet adapted for working long submarine cables. His next step was to enumerate the different causes of interruptions in submarine cables, and explain how they were localised by electricians, drawing an analogy, by diagrams, on the black-board, between the Wheatstone's bridge and a tradesman's balance. He showed how the position of a fault as determined by the electrician was converted into nautical miles and pricked off in the chart, and how those on board the telegraph steamer grappled for and repaired the cable. Mr. Jamieson then went on to enumerate and explain the different forms of grapnels used, and he pointed out the advantages to be derived from working with the patent self-relieving grapnel, which was not so liable to be broken amongst rocks. A small piece of cable picked up from 2,000 fathoms by Mr. Phillips, electrician, and Captain Goodsall, of the s.s. "Chiltern," off the coast of Spain, after having been down ten years was exhibited. This, he said, might be considered the greatest feat in the repairing of submarine cables yet effected. The lecture was throughout attentively listened to and the speaker was frequently applauded. The usual votes of thanks were passed at the close.

TELEGRAPH SHARE LIST.

COMPANIES.	CLOSING PRICES OCT. 13.		BUSINESS DONE WEEK ENDING OCT. 13. Highest.	Lowest.
Anglo-American Ordinary	63½,	¾	64⅝	63⅝
Do. "B"	95½,	⅝	96½	95⅜
Do. "A"	33½,	½	34⅞	33½
Brazilian	10,	⅛	10⅛	9⅝
Cuba	9,	½	—	—
Do. Ten per Cent. Pref.	16½,	¾	16½	16⅜
Direct Spanish	1¾,	2¼	2	2
Do. Ten per Cent. Preference	11⅜,	12½	—	—
Direct United States	12 11-16,	13-16	12⅞	12⅝
Eastern	9 15-16,	10 1-16	10	9 15-16
Do. Six per Cent. Debenture	106,	109	106½	106½
Do. Five per Ct. do. 1899	104,	106	—	—
Do. Six p Ct. Pref	12⅝,	⅞	12⅞	12⅝
Eastern Extension	10¼,	⅜	10⅜	10⅛
Do. Six per Ct. Deb	109,	111	—	—
German Union	9¾,	10¼	—	—
Globe Telegraph & Trust	6 15-16,	7 1-16	7 1-16	6⅞
Do. Six p Ct. Preference	12⅜,	⅝	12⅝	12⅜
Great Northern	9¾,	10	10	9 15-16
Indo-European	24½,	25½	—	—
Mediterranean Extension	2¾,	3¼	3⅜	3¼
Do. Eight p Cent. Pref	10¾,	11¼	—	—
Reuter's	10⅜,	11⅜	—	—
Submarine	240,	250	247	246
West India and Panama	1 5-16,	7-16	1 7-16	1⅜
Do. Six per Cent. 1st Preference	6⅝,	¾	7 1-16	6¾
Western and Brazilian	7 13-16,	15-16	7⅞	7½
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	103,	105	103½	102½

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ABSTRACTS OF SPECIFICATIONS.

—o—

[*We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts*—Ed. *E.*]

814. Telephone Wire or Cables, *J. H. Johnson.—Dated 24th February*, 1880.—(*A communication*) 6*d.*

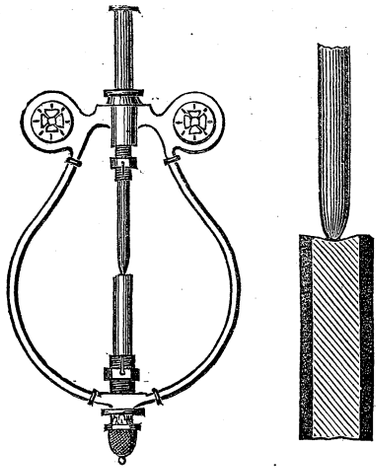
The cable employed consists of a conducting wire surrounded with an insulating material, covered externally by a wire wound in helical coils, serving for the communication with earth.

832. Electric Lamps, *The Hon. R. T. Broughham.—Dated 25th February*, 1880. 6*d.*

The vessel containing the lamp is surrounded with a separate vessel, in which a suitable liquid is placed to cover the joint and prevent the entrance of air. This has already been illustrated and described in *The Electrician*.

842. Producing Electric Light, *A. M. Clark. Dated Feb. 25th*, 1880.—(*A communication.*) 6*d.*

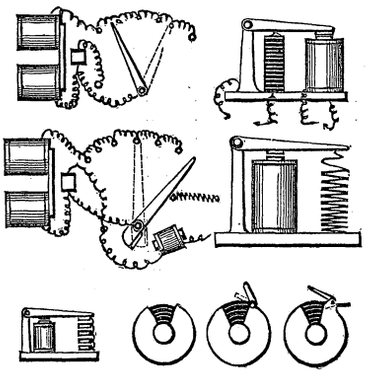
In this lamp the carbons are regulated automatically by the action of gravity, a special arrangement of the electrodes being employed, consisting of an ordinary carbon, and a carbon having a *central core of non-conducting material*, with the centre of which the point of the other carbon is in contact. The regulation is effected by the more or less rapid fusion of the non-conducting core according to the intensity of the current. The



figures show an elevation of the lamp, and the mode of contact of the point of the solid carbon with the non-conducting core of the carbon. The lamp frame consists of an upper and a lower part made of metal or other suitable material, united by curved arms of non-conducting material. The lower part carried a carbon holder, the upper part also has a holder through which the carbon slides freely.

849. Dynamo Electric Machine, &c., *H. J. Haddan.—Dated 26th February*, 1880.—(*A communication.*) 6*d.*

The magnetic field of the machine is weakened either by shunting away from the coils of the field magnets a portion of the current which excites them, or by cutting out or short circuiting some portion of one or more of the coils, so that the current shall make a less number of convolutions about the cores of the magnets. The resistance of the shunt circuit may be varied by hand or automatically, and one or more of the magnet helices of a machine may be included in that part of the circuit affected by the shunt. One end of the conductor formed by these helices is attached to the corresponding (first) commutator brush, while the other end is attached to a binding post, forming one terminal of the machine, and the other (second) terminal is connected with the corresponding (last) commutator brush. Between the second terminal and the first commutator brush a variable shunt conductor is inserted. The figures show a portion of a dynamo-electric machine, provided with a shunt of manually adjustable resistance round the field magnet circuit, and modification by which the operation is performed automatically. The lower figures



show magnetic coils arranged to be short circuited, or cut out of circuit.

855. Lighting Gas, *C. L. Clarke and J. Leigh.—Dated 14th February*, 1880.—(*Not proceeded with.*) 2*d.*

This relates to a lamp for lighting gas by means of electric spark, sparks, or platinum wire heated by the electric current.

860. Magnetic Appliances and Garments, *G. Green.—Dated 27th February*, 1880.—(*Not proceeded with.*) 2*d.*

On a suitable fabric is placed a layer of zinc gauze, to which is attached a layer of copper or other suitable metal gauze. The whole is bound together by means of wire.

872. Magneto-electric and Dynamo-electric Machines, *D. G. FitzGerald.—Dated 28th February*, 1880. 6*d.*

Instead of rotating the ring with its coils between the poles of a magnet on the ordinary system, magnets are employed, electro or permanent, either wholly or partially surrounding the ring, both longitudinally and transversely. Illustrated and described in No. 19, Vol. V.

878. Pneumatic Telegraphic Apparatus, *W. Morgan-Brown.—Dated 28th February*, 1880.—(*A communication.*) 6*d.*

This consists of a pneumatic telegraph apparatus in which a pressure of air arriving through suitable tubes operates a lifting plate, which in its turn acts through suitable intermediate mechanical parts so as to expose to view a number or other mark, indicating from whence the signal has come, and at the same time to set in motion an alarm apparatus driven by a coiled spring, and which is common to all the number or marks contained in the apparatus.

886. Obtaining Electricity, *C. W. Harrison. Dated 28th February*, 1880.—(*Not proceeded with*). 2*d.*

A series of coils or helices of conducting material is employed in combination with an interior central bar or tube, or series of bars or tubes, the motion of which, within the said helices and in the direction of their length, causes electric currents within them.

1553. Electric Lamps, *C. D. Abel.—Dated 16th April*, 1880.—(*A communication.*) 6*d.*

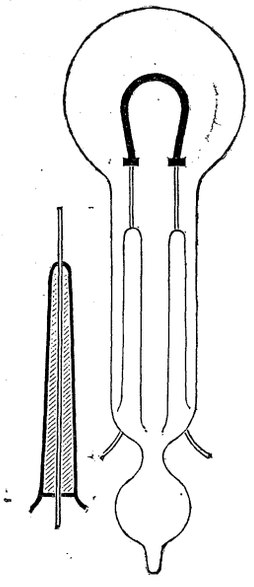
This consists partly in effecting the separation of the carbon points after kindling by means of an armature attracted to an iron sheathing of the directing coil, which is rendered magnetic by the passage of the lamp current.

1998. Magneto-electric Machines, *W. R. Lake.—Dated 14th May*, 1880.—(*A communication.*)—(*Complete.*) 6*d.*

This relates to an armature made as nearly as practicable in the form of a disc, and revolves between magnetic poles of opposite name. This disc is made of insulated wire so as to prevent the transformation of the electricity into heat, the curreuts being kept apart and carried away.

2037. Electric Lamps. *W. Clark. Dated 19th May*, 1880.—(*A communication.*) — (*Complete.*) 6*d.*

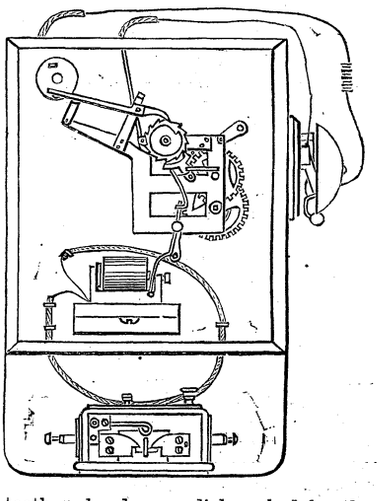
The glass vacuum chamber containing the electrodes and sealing tubes is so constructed that the tube is closed around the wire at the portion least subject to expansion and contraction, and the wire in that portion most subject to expansion is free to expand and contract without affecting the glass. The tube for drawing the air and the tubes for containing the wires are both formed at one side of the globe, so that the latter may be made nearly spherical and of uniform thickness.



In the sealing tubes mercury or dry plaster of Paris, chalk or other dust or powder is used to form an air-tight seal round the wire. A second chamber is provided, into which the residual air passes when the lamp is in use. The larger of the two figures represents the lamps formed with the secondary chamber; the smaller represents one of the sealing tubes.

2136. Signal Apparatus for Telephonic or Telegraphic Purposes, *W. R. Lake.—Dated 25th May*, 1880.—(*A communication.*)—(*Complete.*) 6*d.*

This consists of improved means to prevent the ringing of all of the signal bells of the different stations in an electrical circuit, and to cause only the bell of the particular station to which the message is to be sent to be sounded, the others remaining silent. A train of clockwork is provided with a dead beat escapement. The armature of an electro-magnet carries an upwardly projecting arm, which vibrates a rod. This can be operated from any station in the circuit. Each vibration permits the escapement wheel to pass



half a tooth, a hand on a dial worked by the escapement indicates the number of the telephone station. On the arbour of the 'scape wheel is secured a disc with one notch. Against the periphery of the disc rests a lever, so placed that when the notch in the disc passes its lower end the latter drops and the other end comes in contact with a stud by which local circuit is completed. A call-bell is then sounded notifying the desired communication.

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	—	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	St. Pierre.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia.	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

ADDRESSES.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

W. T. GLOVER and Co., Insulated Wire Manu-facturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manu-facturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

THE GLOBE TELEGRAPH and TRUST COMPANY (Limited).
Notice is hereby given that INTERIM DIVIDENDS for the quarter ending 18th October, 1880, of 3s. per share on the Preference Shares, being at the rate of 6 per cent. per annum, and 2s. per share on the Ordinary Shares, being at the rate of 4 per cent. per annum, both free of Income-tax, will be PAID after the 18th inst. The Transfer Books of the Company will be closed from the 11th to the 18th inst., both days inclusive.
By order of the Board,
WILLIAM PAYTON, Secretary.
66, Old Broad-street, E.C., London, 8th October, 1880.

THE LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY (Limited).
Notice is hereby given that an INTERIM DIVIDEND for the six months ending 30th September, 1880, of half-a-crown per share, free of Income-tax, will be paid after the 1st November next.
The transfer books will be closed from the 23rd inst. to the 1st November, both days inclusive.
By order, WILLIAM PAYTON, Secretary.
66, Old Broad-street, London, E.C., 13th October, 1880.

EQUITY and LAW LIFE ASSURANCE SOCIETY, 18, LINCOLN'S INN FIELDS, LONDON, W.C.
CAPITAL, £1,000,000, FULLY SUBSCRIBED.
The most stringent tables have been used in valuing the Society's liabilities. Lapsed Policies are revived within the period of three months upon payment of the overdue premium and a small fine, without evidence of health. Whole-World Licences will be granted in most cases without payment of extra premium. Nine-tenths of the profits are divided among the assured every five years. At an extraordinary general meeting held on June 9, 1875, the sum of £844,379 was set aside as the value of the Society's liabilities under its Assurance and Annuity Contracts, and £173,180 was ordered to be divided as bonus; leaving a balance of undivided profit of £20,033. Nine-tenths of the sum divided was allotted among holders of policies for £2,500,000.
TABLE OF THE TOTAL ADDITIONS MADE UP TO DECEMBER 31, 1874, TO POLICIES OF £1,000 EACH.

Ages at Entry.	NUMBER OF PREMIUMS PAID.					
	Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	—	—	787 10 0	517 0 0	310 10 0	137 10 0

G. W. BERRIDGE, *Actuary and Secretary.*

ESTABLISHED 1851.
BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

NOTICE OF REMOVAL.
EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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SLIP

EDINBURGH.—The electric light is to be tried immediately in the Museum of Science and Art.

WEST INDIES.—The telegraph cable between St. Thomas and Porto Rico is again in working order.

LIGHTNING PROTECTION FOR TELEGRAPHS.—A paper bearing this title appears in this month's *St. James's Magazine*.

KING'S COLLEGE.—Part of Professor Huntington's work with his classes in Metallurgy is to investigate the properties of metals.

NEW YORK.—Nearly all the large drapery firms in New York are now using the electric light both inside and outside their premises.

MARRIAGE.—CHEESMAN-DURAND.—On October 9, at the British Consulate and St. George's Chapel, Lisbon, Henry G. Cheesman to Emily Mary Durand.

THE BRUSH LIGHT COMPANY (NEW YORK).—This Company expects shortly to have some 300 lights burning in the district of Madison and Union Squares. Offices have been opened at 860, Broadway.

CAMBRIDGE.—Lord Raleigh will, during this term, lecture on Galvanic Electricity and Electro-Magnetism in the Cavendish Laboratory, and Mr. Glazebrook will give an elementary course in Electricity and Magnetism.

ELECTRIC LIGHTING.—The Chamber of Commerce at Rouen have decided to introduce the electric light on the quays of that city. Messrs. Siemens Brothers have charge of the enterprise.—*La Lumière Electrique.*

HORSE RACING AND THE TELEGRAPHS.—Upwards of six thousand five hundred telegrams were disposed of at Newmarket on the day of the Cesarewitch. This, we believe, is one of the heaviest day's business on record at any race meeting.

THE "DACIA."—The ss. "Dacia," belonging to the India Rubber, Gutta Percha, and Telegraph Works Company, arrived at Silvertown on the 15th instant from the Mediterranean, having laid the Triplicate Marseilles and Algiers cable successfully, the whole cruise having only occupied five weeks.

PRICES.—The prices quoted for gutta percha are the same as last week, while india rubber is slightly firmer, the quotations being for Para (fine) 3s. 3d., negrohead 2s. 3d., Central American 1s. 9d. to 2s. 3d., Assam and Pegu 10d. to 2s. 3d., other East Indian 1s. 4d. to 2s., and Madagascar and Mozambique 1s. 7d. to 2s. 3d.

EDISON'S PATENTS.—It is said that in the course of the last eleven years Edison has taken out 233 patents. He has no less than thirty-five patents relating to automatic telegraphs, eight to duplex and quadruplex, thirty-eight to telegraph printing, and eight more to trifling emendations of the Morse alphabet in one way and another.

PROFESSOR GRAHAM BELL.—During his recent visit to Paris to receive the Volta Prize, Professor Bell performed some successful experiments with the Photophone, using the electric light instead of that of the sun. We hope that Professor Bell will explain and illustrate his discovery before our own Society of Telegraph Engineers during the forthcoming session.

ENLARGEMENT OF THE CENTRAL TELEGRAPH OFFICE.—A contemporary announces that certain structural alterations are in contemplation at the General Post Office in view of the requirements consequent upon the reduction of the tariff. Several other things besides structures will, it strikes us, have to be enlarged before that much-talked-of reduction can be safely introduced.

M. GAUGAIN.—We have received a little pamphlet, entitled "Notice sur la vie et les travaux de M. Gaugain, par M. Th. Du Moncel," extracted from the Proceedings of the National Academy of Caen. M. Gaugain performed a vast amount of excellent work, which we shall refer to at the earliest opportunity, and has found an able eulogist in the illustrious Membre de l'Institut, the author of this notice.

OVERHEAD WIRES.—We are glad to notice that the local authorities are beginning to take precautions against accidents by the fall of overhead telegraph wires in public thoroughfares. The Commissioners of Police in Dundee have issued stringent orders that no such wires be erected in that town unless the position, direction of the wires, and the mode of affixing them, be first approved by the Commissioners.

INDUCTION AND INSULATION.—Mr. E. F. Phillips, of Providence, has patented a method which he, of course, hopes will supersede the older methods of covering conductors. Heretofore, he argues, insulated conductors have had a metallic sheath of foil wound spirally, to carry away inductive circuits. He would put the foil on straight, and by this means he maintains that it is less liable to injury as the foil is bent and handled.

FIGURES BY TELEPHONE.—A despatch was lately forwarded from Berlin to a Secretary of State who was travelling in the provinces, and was transmitted over a short distance of the way (13, 4 kilometres) by means of the telephone. It is sometimes said that ciphers cannot be correctly rendered by this instrument; but the message in question contained 650 ciphers, which reached their destination without a single error.—*La Lumière Electrique.*

SOUTH AMERICA.—The directors' report to the shareholders of the Buenos Ayres Great Southern Railway states that there has been an improvement of 10·61 per cent. from the increased use of the telegraph wires by the public during the half year ending July 31, 1880. It may be noticed, however, that the working of the telegraph system was stopped for 25 days during the period in question, otherwise, no doubt, the improvement would have been still greater.

ACADEMY OF SCIENCE.—At the meeting, Oct. 4, M. Perrier presented a memoir on the determination of longitude, latitude. &c., in Africa, at Gèryville, Laghonas, Biskra, and Carthage in 1877-8. With the apparatus used, the time of signalling from chronograph to chronograph could be calculated for distances between 414 km. and 1,236 km. The mean velocity with the resistances used was found to be about that at which an electric signal would go round the earth in a second.

GOVERNMENT INDO-EUROPEAN TELEGRAPHS.——Lieut.-Colonel Bateman Champain, R.E., late president of the Society of Telegraph Engineers and Director-in-Chief of the Government Indo-European Telegraph Department, left London last week for Teheran on a tour of inspection of the British Government land lines through Persia and of the Persian Gulf cable. Colonel Champain, after visiting all the

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stations through Persia and in the Persian Gulf, proceeds to India to report to the Government of India.

TELEPHONE EXTENSION.—Telephone communication has been established in New Albany, Ind., and Louisville. By this time the Connecticut Telephone Company have connected New Haven with Derby, Birmingham with Ansonia, and is at work connecting Birmingham with North Haven, Branford, Guildford, and Milford. Hartford and New Britain will soon be connected, Thomsonville and South Manchester, Windsor Locks and Pognonock will follow. Go on America. Tell us the work you are doing, and we will follow *afar off*.

EDISON'S ELECTRIC LIGHT.—Commenting in a sarcastic vein upon Mr. Edison's latest announcement, *La Lumière Electrique* exclaims "Edison has spoken. An article bearing his name and the modest title, 'Success of the Electric Light,' assures us that the thing is accomplished. We can, therefore, no longer doubt it, for he himself has said it. We should have liked some statements less enthusiastic and more precise; but so long as the author and his countrymen are satisfied we have nothing more to say. Happy Edison! Happy America!"

APPARATUS FOR LIGHTING GAS.—Mr. C. L. Clark and Mr. J. Leigh, both of Manchester, have secured through the Patent Office provisional protection in respect of an improved apparatus which they claim to have invented for lighting gas. The object of the invention, as stated in the specification, is to construct a convenient, durable, and portable form of hand lamp or apparatus for lighting gas, by means of electric spark, or platinum wire heated by the electric current. This lamp is said to be especially adapted for use in mills, cotton, or other factories, warehouses, and other places where there is a danger of fire if the ordinary means of lighting are employed.

THE ELECTRIC LIGHT AT THE BRITISH MUSEUM.—The preparations for lighting the British Museum by means of the electric light were completed on the 18th October, and notices were posted on the reading room door that the library would remain open on and after that day till seven o'clock during the winter months. Experiments made have shown that the present means of lighting will be all that need be desired. There will be a steady clear light, without any of that flicker which rendered other experiments ineffectual. The lights are far more powerful than formerly, and are extended to the King's Library and adjoining rooms; but at present the galleries and other parts of the museum, except the library, will be closed daily at four o'clock, as the electric light has not yet been extended in that direction.

THE CELEBRATION OF THE COMPLETION OF COLOGNE CATHEDRAL.—A successful experiment has been made at Cologne with the electric light for the purpose of illuminating the newly completed Cathedral, both inside and out. The experiment was made under the direction of Herr Böddinghans, the Dusseldorf agent of Messrs. Siemens and Halske, of Berlin, and it has amply repaid all the labour bestowed upon it by the brilliant effect obtained, which promises to add greatly to the charm of the *fêtes* about to be held in the Rhenish city. The lofty spires were lit up to the very top, and shone with a dazzling splendour which made the scaffolding which still encloses them look like a slender wire fretwork, setting them off to all the greater advantage instead of obscuring the view.

TELEGRAPHS AT HOME AND ABROAD.—The paragraph under this heading which we quoted last week from a contemporary turns out to be, as we suspected, very misleading. The accusation against the English Post Office was that in the eight years 1872-80 only about 100 additional offices had been opened, whilst those in several continental countries had increased by thousands. The facts are that between 1869 and 1879 the English offices increased from 2,488 to 5,331. This was accomplished mainly between 1870 and 1872, and the requirements of the country were then almost satisfied. What, therefore, our contemporary calls the "miserable stagnation" since that period, is really the sort of stagnation represented by a brimming tumbler. That other countries have latterly been more active than we is simply because they were previously a long way, and a long while, behind us.

POLITICS AND TELEGRAPHY.—Lord Sherbrooke, better known as Mr. Robert Lowe, writing in the October number of *The Nineteenth Century*, concerning "obstruction," says:—"Time was when the whole talking of the House was performed by some forty or fifty members, but that was in the days of mail coaches timed to run at the stupendous speed of seven-and-a-half miles an hour, and of letters that cost eightpence apiece. The telegraph has made the change complete, and has made the House of Commons much more like the council of a single city in immediate contact with its constituents than the delegates of remote communities."

A CELESTIAL EXPLANATION.—His Excellency, Liu Ta-Jên, a dignitary of the Chinese Empire, much the same as was Mr. Lowe in the British Empire, writing on a similar subject in his diary of a visit to England, says:—"To get possession of trading stations all over the world, for the advantage of her commerce, is a principle of British policy; but being unwilling to face the expenditure which the maintenance of large garrisons at many points would involve, the British at last *hit upon the expedient* of telegraph lines and steam-vessels." There is here a slight confusion of cause and effect; but His Excellency is perfectly clear as to the superiority of his countrymen to these "strange devices" of the outer barbarian. For twenty centuries or more China has been content to remain just what she was. In this respect there is something to be said for Liu Ta-Jên that cannot be said for Lord Sherbrooke. Humanity, justice, moderation in his desires are the only kinds of wealth coveted by the Chinese, and they have what they desire—at least so says the Chinese ambassador. On the other hand, the English peer's latest utterance is one long lamentation over the failure and imminent break down of our political, and possibly our social system. Truly the telegraph has much to answer for.

SCIENCE AND THE CREEDS.—Mr. Frederic Harrison in his account of the creeds, old and new, is very severe upon the modern scientists. "To talk of science, enlightenment, and the like, solving all human difficulties is," says Mr. Harrison, "an idle sophism. The multitude of detached researches on infinite physical problems, the encyclopœdia of special inquiries into Nature, which calls itself science, is as powerless to ensure man a complete and worthy life, as chemistry would be powerless to guarantee the conditions of a happy marriage, or of a great Epic poem." Further on the writer asserts that "the growth of science is quite imperfect, indeed almost rudimentary so long as science, popularly so called, means only knowledge of physical truths, of Nature—not of Man and Man's Society and Soul." The men of science, Mr. Harrison here refers to must be, we fancy, the "lop-sided" persons whom Prof. Huxley described in his recent lecture at Birmingham—men who are all science and have no general culture. To such as these Mr. Harrison's concluding words are perhaps not ill-timed;—"Science will not have its true sense until it implies the entire science of man,

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man as a moral and intellectual being as well as a material organism."

THE SOCIETY OF TELEGRAPH ENGINEERS.—With reference to the proposed change of the title of this society a correspondent furnishes us with the following particulars of papers read before the members since 1873. On subjects directly relating to the working of telegraphy—embracing new forms of batteries, novel apparatus, and improved means of signalling, no fewer than fifty two papers have been read. Of these barely half a dozen have had any reference to *working* submarine lines. On the miscellaneous application of electricity, as for example to the purposes of warfare, to illumination, as a motor, and the like, twelve papers appear on the list. Of purely scientific papers, that is to say of papers relating to electrical phenomena apart from their practical application to telegraphy, our informant cannot discover more than some six or eight at the most. Turning to the engineering part of the programme, he finds that the erection of lines, laying of cables, and the materials employed in telegraph construction have occupied the attention of the society only fifteen times.

ELECTROLYTIC ESTIMATION OF NICKEL AND COBALT, BY H. FRESENIUS AND F. BERGMANN.—Very accurate results are obtained by the electrolytic precipitation of nickel and cobalt, either together or separately, from solutions which contain in 200cc., 0·1—0·15 gram. of metal as sulphate, 2·5—4 grams. of ammonia ($N H_3$), and 6—9 grams. of ammonium sulphate. The electrodes of which the negative is a platinum cone, the positive a wire spiral, are placed $\frac{1}{3}$—$\frac{1}{2}$ cm. apart, and the current—best generated by a Clamond's thermopile—should be of such strength as to yield by decomposition of water 200cc. of mixed gases in an hour. The precipitation takes 5—6 hours. The completion of precipitation can be ascertained by adding a few drops of solution of ammonium sulphocarbonate, which should only give an extremely faint tinge, rose colour with nickel, wine yellow for cobalt. Deficiency of ammonia injures the results, excess has no effect beyond increasing the time necessary for complete precipitation. Ammonium carbonate can be substituted for the sulphate, but retards the operation. Ammonium chloride or nitrate almost entirely prevents the precipitation.—*Journal Chem. Soc.*

ACCIDENT ON BOARD THE "LIVADIA."—The *Times* correspondent, writing of the voyage of this vessel from Glasgow to Brest, after describing the stability, &c., shown, speaks of the electric light apparatus, and gives details of a sad accident which occurred off Brest. He says:—"Here (with engines and boilers) also is the elaborate machinery for lighting the ship, and it was here that a melancholy catastrophe occurred. There are eight engines, each of 15-horse power, placed below to work the eight electro-dynamic machines, each of which provides for four electric lamps of the Jablochkoff system. On Saturday evening a lamp was being hoisted in the stoke-hole, and a stoker was asked to support it temporarily. The electro-dynamic machine was at work, and the current was complete. The man unfortunately placed his hands in such a position as to divert the current from the candle and pass it through his body. He was struck dead in an instant. No medical skill could revive him, and in a couple of hours the entire crew that could be spared from actual work on the ship, with Admiral Popoff and the officers, were chanting the service for the dead. It was designed originally to carry his body to Brest for burial; but it was found on Sunday that the tissues of his frame had been so rent and blackened that a burial at sea was resolved on. The steamer was brought to off Ushant at about 10 o'clock on Sunday morning for the funeral service, and the occasion will not readily be forgotten by those who took part in it. The dead lay covered by the Russian flag, with his amulet upon his breast. Above was a picture of the Saviour, and at his feet an altar, with all the accompaniments of holy water and incense. His shipmates formed a crescent on one side, and the officers on the other, while Admiral Popoff and his friends formed a centre group behind the priest in black vestments. The priest and the seamen chanted in turns in melancholy monotone, and at the end every man knelt and kissed the cross upon the dead man's breast. Then his body was borne by the Admiral and the officers upstairs to the side of the ship and cast into the sea on the instant that the cannon boomed across to Brest."

THE "IRONMONGER" ON NICKEL-PLATED HARDWARES.—There is promise (says our contemporary) of additional attractiveness being given to not a few hardwares by the extended adoption of the process of nickel-plating. The subject is of much interest to the ironmonger, whose business in its most profitable branches is largely promoted by the greater pleasure which buyers with an artistic taste derive from the appearance of an article. It is no new thing for nickel-plating to be applied to hardwares even in England; but it is indicative of the growth of the application that Wolverhampton has been added to Sheffield and Birmingham as a seat of the industry. Experience only can decide as to what articles the process is best adapted. The ordinary japanned trunk-lock, with its clasp and face of brass, it was at first thought, could be replaced with pleasing effect by the nickel-plated article, but time seems disposed to declare against the innovation. The nickel-plated lock requires too much cleaning to maintain its attractiveness under the frequent changes of temperature and exposure to the air to which upon a travelling trunk it is subjected to oust the less costly brass lock. To tea and coffee-pots, however, and to dish-covers, the process is in growing use. At this there is no cause for surprise, since the nickel-plated goods of this class have an appearance of value in excess of tin goods, which far more than compensates for the difference in price. The subsisting considerable demand for the oval-shaped teapot in nickel is aided by the prevailing taste for articles having the outline, and as much as practicable the colour, also, of those in which our ancestors delighted when they sipped tea and rejoiced over the victories of Marlborough. Nickel cream jugs and circular waiters smile upon us at the breakfast table, and are no less cheery when the tiny cup of old Mocha crowns the social pleasures of the day. The nickel plated furniture of coal vases is the more attractive accompanied with the embellishments of a similar class now becoming more general in connection with fenders and fire irons, whether of modern design or associated with the dogs upon which the subjects of Queen Bess lavished their armourers' ingenuity. Nor has an end been seen to the application of the process to the hearth's surroundings. A few coal vases are just appearing, in which the hand shovel, upon being unwrapped, flaunts itself in all the resplendence of nickel. The satchels which will this Christmas for the first time grace the hand of some of England's fairest daughters will be all the safer and all the prettier for the locks and the fittings upon which the nickel-platers are now busy, and the splendid racing stud of his Grace of Westminster will be none the less safe because the duke's stable door fastenings are now suitably embellished with nickel; while the engines of certain of our ocean going steamers will be no more liable to break down because this metal has made certain of the fittings at once more winsome and more enduring.

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CORRESPONDENCE.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Mr. Gordon begins his letter in your last issue with a very positive declaration that "he does not know in which direction any current of electricity flows;" yet he ends his letter by offering for £50 to prove "that a current of negative electricity flows from the rubbers to the earth." And for another £50 he will prove "there is a current of positive [electricity] from the ground to the rubber." Or, in plain language, Mr. Gordon offers for £50 to prove that *black* is *white*, and for other £50 to prove that *white* is *black*. His letter is a brief sample of the sophistry which has been written about the alleged two electric fluids for the last hundred years. It is high time a change was made in this respect. I shall not follow Mr. Gordon in his declaration that he does not know in what direction a current of electricity flows. On the contrary, you have herewith a letter containing a description of a test for ascertaining the direction of currents of electricity which I discovered forty-one years ago, and which I have never found to fail when suitably applied. As the letter was originally published in a local newspaper, copies of which have been unobtainable for more than thirty-five years, the contents of it will be new to your readers.—Yours, &c.,

JAMES JOHNSTONE.

Craiglockhart Hydropathic, near Edinburgh, Oct. 18.

Copy of the principal part of a letter which was published in Greenock on the 27th of December, 1839:—

"NEW THEORY OF ELECTRICITY.

"To the Editor of the *Greenock Advertiser*.

"Sir: In order that my discoveries may be the better understood by the generality of your readers, I shall first give a short account of the two theories of electricity which have been suggested for the purpose of explaining the different electrical phenomena which are already known. I shall then explain the action of the Leyden jar according to these two theories, and afterwards compare its action as explained by these theories with the facts I have discovered. The first theory is that of two electric fluids. It was suggested by M. Dufay, a French philosopher. He imagined that these two fluids, which are now called by the names of positive and negative electricity, possess the following properties: That they are both universally diffused, and therefore present in all bodies, each repulsive to its own particles and as strongly attractive to those of the opposite kind, and that electrical excitement is caused by either of the two fluids being in excess. The second theory is that of a single electric fluid. It was proposed by Franklin, in America. He supposed that all bodies are composed of the electric fluid and common matter, and that the particles of the electric fluid were strongly repulsive to one another, and as strongly attractive to the particles of matter; also that the particles of matter were strongly repulsive to each other, and that they had as strong an attraction for the electric fluid; and when a body exhibits no signs of electricity it is composed of electricity and matter. The reason why it exhibits no signs of electricity is that the mutual repulsive and attractive forces of the electricity and matter of that body are balanced.

"These two theories have each had their respective supporters, but as the theory of M. Dufay gives a more satisfactory explanation of most electrical phenomena it is at the present time all but universally adopted. The Leyden jar was invented by Professor Muschenbroeck, of Leyden, for the purpose of collecting a quantity of electricity. It is constructed of a common wide-mouthed glass bottle, covered partially externally and internally with a coating of tin-foil; it has also a brass rod passed through the cork, with a ball on the top of it, for the purpose of charging it with electricity. The power of this jar to give shocks was accidentally discovered by Muschenbroeck's assistant touching the ball with one hand while he held the jar in the other. The reason why the Leyden jar gives a shock remained unexplained until Dufay and Franklin published their theories of electricity. Dufay imagined that when the jar was charged with positive electricity internally that the external coating of tin-foil became charged with negative electricity, and when it was charged with negative electricity internally the external coating became charged with positive. He also imagined the shock was caused by the two opposite electricities rushing through the arms. Franklin explained the action of the Leyden jar by his theory of one electric fluid thus. He imagined that when the inside coating of the jar was charged with positive electricity, it had received more than its ordinary quantity, and that the outside coating had lost a portion of its usual electricity, and that the shock was caused by the electricity rushing from the overcharged to the undercharged coating.

"I shall now compare these explanations of the actions of the Leyden jar with some of the facts I have discovered.

"First, that a Leyden jar will give a shock or discharge while both its coatings are charged with positive electricity. It will not give a discharge if the quantity of positive electricity is the same on both coatings. One of them must be charged with a larger quantity than the other. [These experiments were made by insulating a Leyden jar on the top of a pillar of shellac one foot in length and one inch in diameter.]

"Secondly, I found that on charging a Leyden jar with positive electricity, and placing the ball of it near a flame of coal gas, that this electricity always caused the flame to be driven with great force from the ball, and that when the jar was charged negatively and the ball applied near the gas flame it always rushed to the ball. Now, according to Dufay's theory, the flame of coal gas is positive, because it was attracted by negative and repelled by positive electricity. To ascertain if the flame was really positive, I insulated it by causing the gas to pass through a long glass tube with a fine point, and lighted the gas as it passed from the tube. The flame thus insulated was not affected in the least by either positive or negative electricity. Why is it that the flame of coal-gas is not affected by either kind of electricity when it is insulated; and that when it is not insulated, positive electricity drives it away from the Leyden jar ball, and negative electricity draws it to the ball? All bodies if insulated and suspended, so that they are moveable, will be attracted and repelled when a charged Leyden jar is brought near them, no matter whether the jar is charged with positive or negative electricity. Now, the flame of gas is very easily moved, yet it shows no signs of attraction or repulsion when it is insulated. [Because its surface cannot be charged with electricity.] When the positively charged jar is brought near the insulated gas flame it must be remembered that the flame intervenes between the jar and the gas pipe, which is a good conductor of electricity; and as it is admitted by the theories of Franklin and Dufay that electricity passes out of a positively electrified jar in the act of being discharged, it is evident that the flame of the gas is pushed away by the electricity, while it is rushing from the jar ball to the gas pipe, and as this flame is always bent in the same direction by the positive electricity rushing from the jar, the law which is established by this fact is—*That the direction in which a current of electricity moves is always indicated by the direction in which it bends the flame of coal-gas.* It has been long known that if a Leyden jar be suspended by silk threads it is impossible to charge it while thus suspended. It has also been observed that if a finger or any other good conductor of electricity be brought near the external coating the jar may then be charged, and whilst it is being thus charged a current of electricity passes between the external coating and the finger or a conductor connected with the earth. To test the direction of this current of electricity, fasten a copper wire to the outside coating of the jar while insulated, and conduct the other end to the flame of the gas, and it will be found by the gas test that when the jar is being charged positively the current of electricity which passes between the outer coating of the jar and the gas-pipe drives the flame of the gas away to the gas-pipe, and when the insulated jar is being charged negatively the current of electricity passing between the outer coating of the jar and the gas-pipe is coming from the gas-pipe to the jar, as indicated by the direction of the gas flame.

"Thirdly, I find that if a bottle similar to that of which Leyden jars are usually made be furnished with a charging wire and a cork well sealed with shellac it will give shocks without either an external or an internal coating of tinfoil.

"Fourthly, I have proved by a number of experiments that the electric fluid passes through the pores of glass.

"The foundation on which Dufay rests his theory is that all electrical phenomena are produced by the repulsive and the attractive forces of the two electric fluids, whereas by the experiments herein described a discharge is obtained between the coatings of a Leyden jar when it is charged with positive electricity inside and out of divers quantities. This fact withdraws the foundation from Dufay's theory; but the law or test of the gas flame shows the error of Dufay's theory in a still more decisive manner when it is applied for the purpose of explaining the action of the friction electrical machine. For this purpose bring the flame of the gas near the ball on the prime conductor of the machine, and it will be found by the direction of the flame that the electricity is rushing out of the couductor; then place the flame near the ball on the conductor of the rubber of the machine, and it will be found that the current of electricity is rushing into it. Now, according to Dufay's theory of two fluids, a current of electricity ought to rush out of both conductors. *The fact is that there is only one electric fluid*, and that when the electrifying machine is put in motion the rubber merely draws

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the electric fluid out of the ground, and the prime conductor gives it out.

"I find the Leyden jar becomes charged with electricity because its charging rod admits more electricity than can pass quickly out through the pores of the glass. The shock is caused by the electricity rushing from the overcharged inside coating to the coating outside, which has not on it a diminished quantity of electricity as alleged by Franklin's theory.—Yours, &c.,

"Willow Park, Greenock, "JAMES JOHNSTONE.
"25th December, 1839."

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Whatever Mr. Johnstone's rejoinder to Mr. Gordon may be, I cannot help expressing the regret, which I think most of your younger readers will share, that the last-named gentleman should have treated his challenger with so much levity. It may possibly be unimportant—though I cannot conceive it to be so—whether the flow of electricity has or has not "a direction at all;" and it may amuse Mr. Gordon to prove clearly two diametrically opposite views; but to students of electricity the difficulties of their task is immensely increased by the fictions with which writers of text books such as his are still content to enshroud their meaning and perplex their readers. Mr. Johnstone directly challenges the view that there are two kinds of electricity; and I suspect that few people indeed nowadays believe in the two-fluid theory. Yet the professional teachers continue to speak—conventionally, perhaps, but explicitly—as if there were two fluids. Even Professor Tyndall talks of two currents, positive and negative, meeting in the middle of a connecting conductor; and Mr. Gordon says it is common to speak of negative electricity travelling *from* its source. But if there is no negative electricity it cannot have a "source;" and though it is a permissible conventionality to speak of negative and positive *poles* as descriptive of their condition, it surely is a misuse of language to speak of electricity flowing from a point at which there is supposed to be none to flow. The statement in Mr. Gordon's book, that the cushions of an electrical machine are connected with the ground, "*so that the negative electricity produced on them can escape*," is one that ought not to be made unless it means something. Instead of telling us what it does mean, or what it is intended to imply, he takes refuge in an attitude of scepticism all round—it means anything you please, or nothing at all, according as you happen to have staked your money. I trust Mr. Gordon will reconsider his answer, and deal with the subject a little more seriously.—Yours, &c., J. L.

London, 18th October, 1880.

ELECTROLYTIC "POLARISATION."

TO THE EDITOR OF THE ELECTRICAN.

SIR: Owing possibly to repeated translations the quotations given by Mr. FitzGerald on page 247 do not fairly represent Dr. Exner's original statements, as appearing in his paper "Zur Theorie der Inconstanten Galvanischen Elemente," published in *Annalen der Physik und Chemie*, No. 8, 1880. When he says that no electromotive force is developed by the "contact of a metal with a gas" it is quite evident from the context that he means that the force is not due to the mere "contact" as such, for he continues referring to his former paper on polarisation. "I have further proved that the polarisation arising in any decomposition apparatus has its origin (in direct opposition to the accepted view) solely in the re-combination of the separated ions, that is in the re-formation of the decomposed electrolyte, and that the electrodes—in so far as they are not chemically changed—play the part only of conductors to and fro of the electricity. The electromotive force of the polarisation is here measured by the heat equivalent of the reverse chemical process, just as the E.M.F. of any cell is measured by the heat equivalent of the chemical process going on in it."

It is true the evolved H in a Grove cell recombines with O to form H_2O, but this is not a recombination in the sense meant by Dr. Exner, viz., a recombination of the H_2 with the O from which it had been separated.

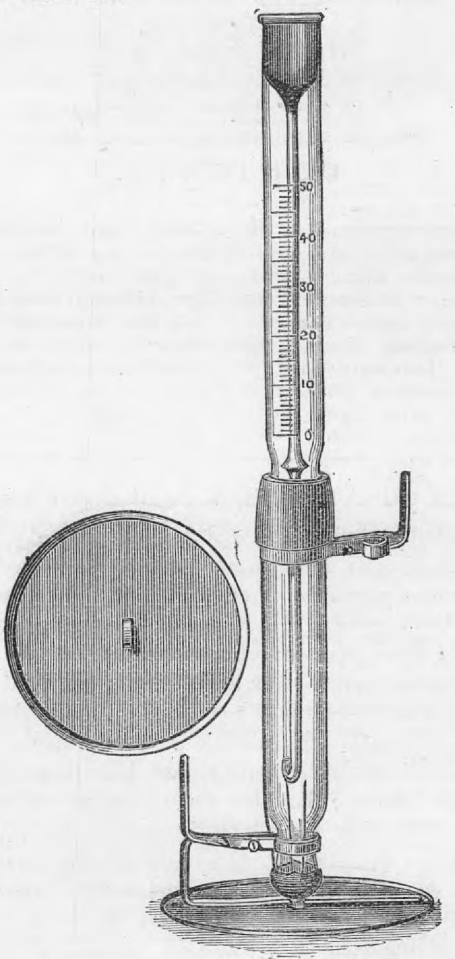
The sentence referring to the heat equivalent of the Daniell cell reads literally:—For one equivalent burnt zinc (there) will become in the Daniell disposable 24,300 calories"—*i.e.*, this is the heat equivalent of the algebraic sum of the chemical actions in this cell as calculated from J. Thomsen's data. The reason for not considering the decomposition in Smee's cell as that of H_2SO_4 is given as follows:—. . . water is decomposed—whether directly, or after separation from SO_3, is equal, since in the latter case the heat required for separation is immediately replaced by the combination of the SO_3 with the surplus water present.

It is, no doubt, true that polarisation is accompanied by the deposition of hydrogen on the negative plate, and this point is referred to by Dr. Exner in his remarks on the decomposition apparatus as given above; but it appears to me that the continental meaning of the word "polarisation," the "accepted view" which he combats, is something different to the English one, and is apparently understood to be intimately connected with the "contact theory," in proof of the falsity of which he has adduced valuable evidence, partly in this paper, partly in three subsequent ones. A translation of the first of these will be found in the current number of the *Philosophical Magazine*, and as the English MS. was examined and approved by the author before publication it may be considered to fairly represent his original work.—Yours, &c. J. BROWN.

Belfast, Oct. 14th, 1880.

PULVERMACHER'S PATENT DOSOMETER.

This little apparatus, illustrated below, is essentially a voltameter adapted to the measurement of small currents, such as are mostly applicable in electro-therapeutics. It is, in fact, intended for medical use; but we think it will frequently be found useful in experimental investigation, when the ordinary voltameter is of insufficient sensitiveness, although of more convenient application than the galvanometer.



In the dosometer, the gases produced by electrolysis are measured indirectly, producing a pressure which causes the ascent of a coloured fluid within a very narrow glass tube, provided with a *millimetre* scale. By means of a simple formula, a current which has passed for a certain number of seconds or minutes, and produced a certain indication on the scale, may be determined in microwebers or milliwebers per second, or in terms of any other unit that may be adopted. The instrument, when separated from the circular metal plate, shown in the figure, admits of being conveniently carried in the pocket. When the dosometer is mounted with this plate, the latter constitutes not only a stand but also a rheophore or electrode for the application of the current in electro-therapeutics, the instrument itself serving as an insulating handle.

The apparatus is very neatly and carefully constructed, and we hope shortly to give some details as to its employment in electrometry.

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THE ELECTRICIAN.

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VAN CHOATE'S NEW CABLE SCHEME.

The enormous capital invested in cable property, the necessity of obtaining as much work as possible out of a cable, causes those engaged in the work to pay close and careful attention to every new idea brought forward purporting to point to improved methods of manufacture or working. In our last issue we printed an article from an American contemporary, which contained professedly new information relating to cable work. The article gave no exact information as to the details of Mr. Choate's plan, but there seems to be little doubt that he has been working in an unprofitable direction. The idea of relays connected with submarine cables is by no means new, although this does not prevent Mr. Choate's plan from being successful. On the 15th August, 1868, Mr. John Macintosh took out a patent entitled "Submarine Telegraphy." Could the history of patents be written, this, among many others, would be found to have originated in a chance expression from the lips of a man of science before a man of business. However, the contents of the patent are what we require, and the following extract will show the idea:—This invention consists in dividing long submarine lines into sections, united by relays in conjunction with local batteries or induction coils (or simply by induction coils), these being enclosed within air and water-tight vessels submerged together, and in connection with the cable at the bottom of the sea, the object being to obtain signals through long submarine telegraph lines with greater rapidity than before, or, the speed being the same, with a reduction in the weight of materials in the core of the cable. The local battery or electromotor sending forward a fresh current by the action of the relay may consist of any voltaic battery of suitable construction (devised to remain in constant action for a considerable period of time), which, together with the relay, are enclosed with the air and water-tight vessel, which is furnished with earth contacts and stuffing boxes, through which latter the two ends of the cable pass and are hermetically sealed. When induction coils alone are used, the cable is enlarged at the point of connection sufficiently to envelop the coil which is submerged with the cable to the bottom.

Mr. Macintosh claims only the dividing of the submarine lines into sections, and uniting them by means of relays. Mr. Choate, it seems to us, unless he has invented something wonderful in the way of relays, has advanced no further than Mr. Macintosh 12 years ago. The theory of halving the length of a line and doubling the speed of work is nothing new. The difficulties in using a relay on an Atlantic cable are more mechanical than theoretical. Will Mr. Choate be good enough to enter into details as to the size and type of cable, and the machinery for laying or picking up, he would use? We confess that we see no way out of the mechanical difficulties that would arise, and hence, till these are encountered, we must simply admit that all seems well in theory, and recur to the What about practice? Further, we find that Mr. Desmond G. FitzGerald, in a patent entitled "Signalling," obtained on the 2nd November, 1875, describes a method of getting increased signalling power without the aid of air-tight boxes, spherical globes, or cases other than the cable itself. Here, again, the theory is perfect, but we have reason to believe that after long-continued trials the plan was given up, it being found that gains on the one side were balanced by losses in another direction.

This invention, says the patent, consists in the construction and use of two forms of current induction apparatus, which, when intended to be submerged with the cable, constitute submarine "translators," containing no adjustments or other parts liable to derangement or deterioration after submersion, and preferably forming portion of the cable itself. By means of such apparatus the cable is divided into two or more distinct circuits, the speed of signalling being thus increased in accordance with what is known as "the law of the inverse square of the length." One form of this apparatus consists of an induction coil with similar primary and secondary wires, the earth contacts being made with platinum rings. In the other form an electro-magnet is the essential feature. In this apparatus, then, the mechanical difficulties are met and overcome, but as we have previously said, other difficulties proved insurmountable obstacles. Mr. Choate has obtained the good word of many eminent scientific men in America, but we fail to recognise amongst them any one whose attention has been specially directed to submarine work. We are not referring to Dr. Paget Higgs, but to the various Professors named in the article.

The question as to what can be patented and what cannot is always puzzling. If Mr. Choate claims the division of cables by relays into sections, does not Mr. Macintosh's patent bar him? If he uses a coil or a magnet how is he to put aside Mr. FitzGerald's priority? It seems to us that he can claim only a relay. The application, if practicable to cables, is common property. When the details of the construction of the relay reach this country we shall probably return to the subject again. Meanwhile, there seems little ground to suppose that Mr. Choate has gone much further than the other gentlemen we have named who have worked in a similar direction.

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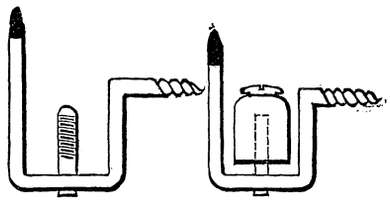
DENORMANN INSULATOR BRACKET.

A most ingenious and practically successful insulator bracket has just been invented by Baron Denormann, the Mediterranean Extension Telegraph Company's manager in Corfu, well known in the engineering world for his numerous improvements in machinery, &c.

The object and obvious advantage of this bracket will be at once seen on reference to the enclosed sketch



Besides supporting the insulator more firmly than any existing bracket it prevents the wire from falling to the ground when it may have slipped from the insulator, broken or split by the thousand and one causes which *do* break insulators; and by coating the iron with some insulating varnish the wire on slipping would in wet weather show a comparatively high insulation, and enable the line to be worked when, in the ordinary course of events, continuity would be extremely difficult or altogether impossible through the line being to earth.

Another advantage, and a very important one for those countries where poles and insulators are so frequently destroyed by electrical discharges, is the lightning guard arrangement formed by the outer arm of the bracket itself, which is considerably higher than the insulator, and effectually brought into communication with the earth by a wire twisted with the bracket into the pole, wound round it, and conducted down to the soil. In many parts of the world sad havoc is made amongst poles and insulators during heavy thunderstorms, and undoubtedly the Denormann bracket should offer great advantage over the primitive lightning protector at present in use.

BRITISH ASSOCIATION.

PRELIMINARY REPORT OF THE COMMITTEE, consisting of Professor W. E. Aryton (secretary), Dr. O. J. Lodge, Mr. J. E. H. Gordon, and Mr. J. Perry, appointed for the purpose of accurately measuring the specific inductive capacity of a good Sprengel vacuum, and the specific resistance of gases at different pressures.

In 1876 two of the members of your present committee concluded from theoretical reasons based on the analogy between the viscous yielding of bodies to mechanical stress, and the absorption of the electric charge in a Leyden jar, that some connection of an inverse order would be found to exist between the specific inductive capacities, and the specific resistances of dielectrics. As at that time it was only for gutta percha and india rubber that the specific resistances had been measured it was necessary, in order to put the theory to the test of experiment, to carefully measure the specific resistances of several other dielectrics, of which the specific inductive capacities were known. The substances selected were paraffin wax, shellac, mica, ebonite, &c., and it was found that in a general way, if bodies were arranged in increasing order of specific inductive capacity, they would be found arranged in decreasing order of specific resistance.*

Again, since different gases had different indices of refraction for light, it was felt that Faraday's not having succeeded in finding experimentally different specific inductive capacities for the various gases must have arisen from the comparative roughness of his apparatus, and very delicate experiments undertaken in consequence showed that hydrogen had a decidedly less specific inductive capacity than air, and that carbonic dioxide, coal gas, sulphuric dioxide, &c., a decidedly greater. Lastly, since the resistance of a gas to disruptive discharge varied with the pressure it was anticipated, also in opposition to the results of Faraday's experiments, that the specific inductive capacity of even the vacuum of an ordinary air-pump must be slightly different from unity, a conclusion also subsequently verified by experiment.†

The method employed for that investigation, which was carried out in Japan, consisted in using two condensers, one an open-air condenser of adjustable capacity, the other a closed condenser into which any gas at any pressure could be put. The open-air condenser was adjusted to have the same capacity as the closed one when the latter was filled with air at the ordinary pressure and temperature. Then, the change in capacity of the latter when the pressure of the air inside was diminished, or when another gas was introduced, could be determined by charging the insulated coatings of these two condensers to equal and opposite potentials, discharging them into one another, and measuring the resultant potential with a Thomson quadrant electrometer adjusted for great sensibility.

Previously, however, to this, but quite unknown to these members of your committee, Prof. Boltzmann had made a similar investigation, using, however, a different method of experimenting. The results obtained in the two independent investigations for the same gases are placed underneath, side by side, and the fairly close agreement, considering the extreme delicacy of the experiments, make it quite certain that the general bearing of the experiments is correct.

	Ayrton and Perry.	Boltzmann.
Air	1·0000	1·0000
Vacuum	0·9985	0·9994
Hydrogen	0·9998	0·9997
Coal gas	1·0004	—
Marsh gas	—	1·0004
Carbonic dioxide	1·0008	1·0004
Sulphuric dioxide	1·0037	—

The gases were at 760 mm. pressure, the vacuum varied from about 10 mm. to somewhat greater pressures. The observation for sulphuric dioxide is given, as it is the highest specific inductive capacity yet obtained for any gas.

The very peculiar behaviour of a good Sprengel vacuum in resisting the passage of an induction spark led to the formation of this committee to investigate, with the aid of a grant from the Association, the specific inductive capacity of a far higher vacuum than had been employed in either of the two preceding investigations, since Messrs. Ayrton and Perry predicted that such a vacuous space would be found to have a capacity very considerably smaller than if filled with ordinary air.

The closed condenser in this case consists of five aluminium cylinders 39·3 centimetres long placed concentrically at about ⅛ centimetre apart in a glass tube 58·5 centimetres long and 5·5 centimetres in diameter. The second and fourth cylinders form the insulated coating, and the first, third and fifth the earth coating. The cylinders comprising each coating are rigidly connected at each end with a thin platinum rod, and these platinum rods like the cylinders, do not touch the glass tube, but are held in position by a thin glass rod, one end of which is fused to the platinum rod, and the other to the inside of the glass tube. To give, in a small space, length to these glass rods for obtaining surface insulation they are made zig-zag, or in the form of a flat spiral. To the thin platinum rods are attached two fine platinum wires, which form the two electrodes of the condenser, and where these pass out through the glass tube glass is fused on to the wire both inside and outside, as in Fig. 1, to increase the surface insulation.

FIG. 1

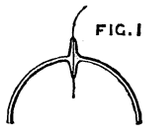
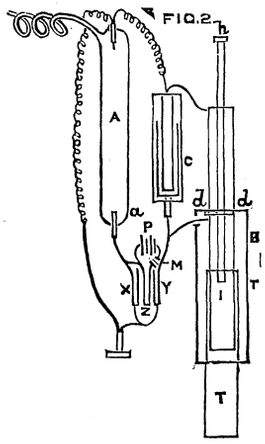


FIG. 2



The area that one set of aluminium cylinders exposes to the other is about 1,800 square centimetres, so that the electrostatic capacity is about 450 centimetres in absolute units, or 1-2,000th of a microfarad.

A small spiral glass tube connects the condenser with a three fall tube Sprengel pump, and as the internal capacity of the condenser is large it was thought desirable to attach to the pump an Alvergniat or Geissler arrangement to enable the pressure to be rapidly reduced to about 10 centimetres of mercury. A barometer gauge and a M'Leod gauge are attached to the pump. The entire glass work in the apparatus was made by Mr. Guningham, and the committee desire to express their thanks for the assistance he has so kindly given.

METHOD OF EXPERIMENTING.—In the accompanying figure A is the aluminium condenser just described, the interior not being shown in the figure, B is Sir William Thomson's "sliding condenser," kindly lent by him to the committee. This, as is well known, consists of a brass tube, I, about 38 centimetres long, and 5·08 centimetres in external diameter, attached at one end to an ebonite collar, *dd*, by which it is supported and insulated. Outside and inside this brass tube, but without touching it, slide two other tubes, T_1 and T_2, electrically connected with the outer tube T_3 and with the earth. The motion of the tube T_1 forms a coarse adjustment, and that of the tube T_2 a fine adjustment of the capacity of the condenser. On account of the action of the edges it would be somewhat difficult to calculate the whole capacity of this condenser for any given position of the tubes, but it is comparatively easy to calculate the change of capacity produced by moving either tube a known distance measured on the fine linear scale engraved on each of the sliding tubes.

As the capacity of this condenser, when the tube T_1 is in its mean position, is considerably less than that of the aluminium condenser, another air condenser, C, having a fixed capacity about equal to the difference, was constructed. B then could be adjusted so that its capacity together with that of C was equal to that of A when A contained air at ordinary pressure. Then any change in the capacity of A produced by exhausting the air could be measured by finding the new adjustment of B necessary to produce balance.

The mode of testing the equality of capacities was suggested by one of the committee, Dr. Lodge, and consisted of a modification of Professor Hughes's induction balance. Z is a coil of wire of about three ohms resistance, in which the current from two or three Grove cells, P, flows intermittantly, the circuit being alternately made and broken by a clock, M. X, Y are perfectly similar coils of about 800 ohms resistance each, and adjusted in

*"The Viscosity of Dielectrics." By W. E. Ayrton and John Perry, *Proc. Roy. Soc.*, No. 186, 1878.

†"On the Specific Inductive Capacity of Gases." By Professors W. E. Ayrton and John Perry. *Trans. Asiatic Soc. of Japan*, 1877.

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position relatively to Z, so that when the condensers on the two sides of the balance have perfectly equal capacity no sound is heard in an especially delicate telephone, T, when the connections are made as in the figure. It will be observed that the nature of the arrangement is such that any failure of insulation in A would make it appear to have too large a capacity, and not too small as would be the case with the method of experimenting previously described.

For air at pressures greater than one millimetre the committee have not thought it necessary to make many experiments, but between 0·01 and 0·001 of a millimetre pressure several sets of experiments have been carried out. At the latter pressure—that is, at about one-millionth of an atmosphere—the specific inductive capacity is certainly low, some experiments apparently making it as much as 0·6 to 0·8 per cent. less than that for ordinary air, whereas the greatest diminution obtained for an air-vacuum in the two previous investigations, when the pressure was not diminished lower than five millimetres, was only 0·1 per cent. In all the sets of experiments for very low pressures there are decided waves in the curves connecting capacity and pressure, but whether these waves really express a physical law, or whether they are due to the method of experimenting with currents of very short duration, or, whether, lastly, they are due to the capacity not depending solely on the pressure, but also on the amount of residual gas occluded in the aluminium cylinders, the committee have not yet ascertained, and, therefore, in this preliminary report they refrain from giving the curves. A sample of the observations, however, may be interesting :—

August 26th.—Pump continuously working.

Pressure in millimetres.	Reading on small sliding cylinder T_2, T_1 remaining stationary.
0·0100	185
0·0041	194
0·0031	165
0·0032	208
0·0020	162
0·0017	140
0·0020	160
0·0018	142
August 28th.—Air being very slowly let in.	
0·0207	314
0·0407	332
0·0568	343
0·0765	350
0·1204	326
0·1924	292
1·0000	320
3·2500	341
5·5000	379
760·0000	395

The readings on either day may be compared one with another, but not those on different days. In either case, however, a difference of 100 in the reading indicates roughly a difference of about 1 per cent. in the capacity of the aluminium condenser. It will be observed that, in addition to the curious fluctuations in the capacity for the same small pressure, a result constantly obtained when very small pressures were employed, and which may have arisen from the effect of the remanent occluded gas, there also appears to be a sudden diminution of the capacity at about 0·19 millimetre pressure. To make sure that this was not an accidental result, the air was pumped out again, when the pressure was about 3 millimetres, until it was reduced again to about 0·1 millimetres when the same diminution of capacity at about 0·19 was again observed. Now, although these numbers are merely now given as a preliminary indication of the results obtained by the committee, there is this interest about them, as has been pointed out by Mr. G. F. FitzGerald, of Dublin, that the values obtained for the capacity between about 0·02 and 0·2 millimetres pressure bear a general resemblance to those obtained for the Crooke's force.

One difficulty met with in the investigation consists in an apparent change in the capacity of the condensers B and C (partly, no doubt, arising from changes of temperature) from day to day. A similar difficulty was met with in the previous investigation made in Japan, but it was overcome by making alternate measurements of the capacity of the closed condenser, first with air, then with vacuum, then with air, &c. In the present case this is, of course, impossible, since, on account of the large internal capacity of the condenser A, and the considerable quantity of gas occluded in so large a mass of aluminium, it takes several days to obtain a vacuum of 0·001 of a millimetre, even although, at the suggestion of Mr. Gunningham, indication sparks from a large induction coil (not shown in the figure) are kept passing between the two sets of aluminium cylinders at all times that a measurement of capacity is not being made. Probably the best method of procedure is that followed on August 28th, the last day of the investigation, viz., first obtain slowly a very perfect vacuum, no measurements of capacity being necessarily made, then admit into the pump, drop by drop, mercury, occluding air, and make, during a couple of hours or so, a complete series of measurements of capacity as the pressure rises from, say, 0·001 of a millimetre up to ordinary atmospheric pressure. Such a set of experiments being performed several times would probably give a fair indication of the curve for capacity. As it is also extremely desirable that the experiments should be made with statical charges of electricity, the committee have had constructed a somewhat modified form of Thomson's quadrant electrometer, which they also propose employing for the measurement of the specific resistance of gas at different pressures, the second half of their work which they have not yet commenced.

THE SUCCESS OF THE ELECTRIC LIGHT.*

Not a little impatience has been manifested by the public at the seemingly unaccountable tardiness with which the work of introducing the "carbon-loop" electric lamp into general use has hitherto progressed. It is now several months since the announcement was made through the newspapers that all the obstacles in the way of the utilisation of the electric light as a convenient and economical substitute for gaslight had been removed; that a method had been invented by which electricity for light or for power could be conveyed to considerable distances economically; that the current could be subdivided almost *ad infinitum*; and that the electric lamp was henceforth to be as manageable for household purposes as a gas-jet. But, so far as the public can see, the project has since that time made no appreciable advance toward realisation. The newspapers have reported, on the whole with a very fair degree of accuracy, the results of the experiments made with this system of lighting at Menlo Park; scientific experts have published their judgments, some of them pronouncing this system to be the desiderated practical solution of the problem of electrical lighting which has vexed the minds of physicists since the day when Sir Humphry Davy produced his famous five-inch voltaic arc. Still, it must be confessed that hitherto the "weight of scientific opinion" has inclined decidedly toward declaring the system a failure, an impracticability, and based on fallacies. It will not be deemed discourteous if we remind these critics that scientific men of equal eminence pronounced ocean steam navigation, submarine telegraphy, and duplex telegraphy impossibilities down to the day when they were demonstrated to be facts. Under the circumstances it was very natural that the unscientific public should begin to ask whether they had not been imposed upon by the inventor himself or hoaxed by unscrupulous newspaper reporters.

Now, the fact is, that this system of electrical lighting was from the first all that it was originally claimed to be—namely, a practical solution of the problem of adapting the electric light to domestic uses and of making it an economical substitute for gaslight. The delays which have occurred to defer its general introduction are chargeable, not to any defects since discovered in the original theory of the system or in its practical working, but to the enormous mass of details which have to be mastered before the system can go into operation on a large scale, and on a commercial basis as a rival of the existing system of lighting by gas.

With the lamp and generator which at the time of the first announcement it was proposed to use, the electric light could have been made available for all illuminating purposes as gas is now; the expense would have been considerably less with the electric light; the lamp would have been quite as manageable as a gas burner. But, fortunately, the unavoidable delay interposed by administrative and economic considerations afforded opportunity for further research and experiment, and the result has been to introduce many essential modifications at both ends of the system—both in the generator and in the lamp; at the same time sundry important changes, all in the direction of economy and simplification, have been made at almost every point in the system, as well as in the details of manufacturing the apparatus.

As for the lamp, it has been completely transformed. The external form of the two types of lamp is identical; the principle of illumination—incandescence of a solid body *in vacuo*—is also the same; but, in the earlier lamp, light was produced by the incandescence of a platinum wire wound on a spool of zircon; in the perfected lamp the source of light is incandescent carbon. Another essential difference between the two is found in the form given to the incandescent body; in the platinum lamp it was coiled compactly on a small spool, in the carbon lamp it is a loop some five inches in total length. This incandescent loop is found in practice to afford a better light for domestic purposes than an incandescent mass of compact form; the shadows it casts are not so sharply defined, their edges being softened.

This loop of carbon is now prepared from the fibre of a cultivated species of bamboo from Japan. A thread of this material, after undergoing a certain chemical process, is bent into the required shape, and then reduced to carbon. The resulting carbon loop is of a remarkably homogeneous structure, and possessed of a high degree of tenacity, so that it can withstand, without breaking, all the concussions it is likely to be subjected to in household use.

The perfected lamp consists of an oval bulb of glass about five inches in height, pointed at one end, and with a short stem three-quarters of an inch in diameter at the other. Two wires of platinum enter the bulb through this stem, supporting the loop or Ω-shaped thread of carbon, which is about two inches in height. The stem is hermetically sealed after the introduction of the carbon loop. At its pointed end the bulb terminates in an open tube through which the air in the bulb is exhausted by means of a mercury-pump till not over one millionth part remains; the tube is then closed. The outer extremities of the two platinum wires are connected with the wires of an electric circuit, and at the base of the lamp is a screw by which the circuit is made or broken at pleasure. When the circuit is made the resistance offered to the passage of the electric current by the carbon causes the loop to acquire a high temperature, and to become incandescent; but as this takes place in a vacuum the carbon is not consumed. The "life" of a carbon loop through which a current is passed continuously varies from seven hundred and fifty to nine hundred hours. With an intermitted current the loop has an equal duration of life; and as the average time an artificial light is used is five hours per day, it follows that one lamp will last about six months. Each lamp costs about fifty cents, and when one fails another may easily be substituted for it.

The light is designed to serve precisely the same purposes in domestic use as gaslights. It requires no shade, no screen of ground glass, to modify its intensity, but can be gazed at without dazzling the eyes. The amount of light is equal to that given by the gas-jets in common use; but the light is steadier, and consequently less trying to the eyes. It is also a purer light than gas, being white, while gaslight is yellow. Further, the electric lamp does not vitiate the surrounding atmosphere by consuming its oxygen, as gaslights do, and discharging into it the products of combustion. The heat emitted by the lamp is found to be only one fifteenth of that emitted by a gaslight of equal illuminating power; the glass bulb remains cool enough to be handled. Of course, there are here no poisonous or inflammable gases to escape, and the danger of fire is reduced to *nil*, with a consequent reduction of the rate of insurance. Again, this light, unlike gas, is always of uniform quality. A sort of meter registers exactly the amount of electricity consumed in each house. Finally, not to enumerate all the advantages which this system possesses over gas-lighting, the lamp can be manipulated even by the most inexperienced domestic servant; nor can the most careless person do injury to himself, to others, or to property, through not understanding its mechanism.

Another important modification of the system, introduced since the latest

* The *North American Review*.

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authorised account of the light was published, is the substitution of dynamo-machines for magneto-machines in the stations from which the electricity is to be supplied to the several districts of a city. Here, again, the change is entirely in the direction of simplicity and economy. Where before it was proposed to furnish a station with one hundred magneto-machines with a multiplicity of belts and shafting, we now make ten dynamos of 120 horse-power, each worked directly by a 120 horse-power engine. We thus do away with a very considerable loss of power, and at the same time the outlay for machinery is very much lessened.

With these and other modifications of the system, which need not be particularised here, it may be safely affirmed that the limit of economy, simplicity, and practicability has been reached. The time for experiment has passed; any further improvements to be made in the system must be suggested by its performance when put to the test of actual use on a large scale.

To the question which is so often asked, When will a public demonstration of the working of this system be made? we would reply that such a demonstration will in all probability be made at Menlo Park within two months from this date. The time which has elapsed since the preliminary demonstration of last January has been by no means a season of inaction for the promoters of this enterprise. There is a vast gulf between the most successful laboratory experiment possible and the actualisation of the results of the experiment in a commercial sense. A prodigious amount of work was necessitated by the establishment of factories for producing the lamps, the generators, and the other essential parts of the system in large quantities, so as to be able to supply the first demand. We were about to enter a field that was practically unexplored, and, even on a preliminary survey, problems of the most complex kind arose on every side. These had to be solved before the first step could be taken toward the actual introduction of the light into our cities as a substitute for gas. The practical engineer and the man of business can best appreciate the difficulties that had to be overcome. Like difficulties have in the past retarded the general introduction of nearly all the great mechanical and chemical inventions. Years intervened between the discovery of photography and the taking of the first photograph; the steam engine, the steamboat, the locomotive engine did not come till long years after the discovery of their scientific principles; the same is true of the telegraph.

But preparations are being actively made for placing this system of electric lighting within reach of the people in all the great centres of population throughout the United States. To this end cities are being mapped and divided into districts, each to be supplied with electricity from a central station; estimates are being made of the exact cost of plant in the different cities; contracts are being negotiated for the manufacture on a large scale of engines, dynamos, lamps, wire, and all the other supplies needed for the practical introduction of the system throughout the country; men are being trained to put up the plant of central stations, to run the machines, and to execute all the details of the introduction and working of the system.

A very important question is that of the cost of this light. The price of the electric light will, of course, be determined by the capitalists who invest their money in it as a business venture, but it will of necessity be low as compared with gaslight, though it will vary according to the original cost of plant, the demand in any given locality, and other conditions. It is not at present the intention of the company controlling the patents on this system to supply the light directly to consumers. The company will erect the first station in New York City, and will themselves conduct that station; but the other stations in New York, as well as in the other cities throughout the United States, will be managed by local companies, who will pay a royalty to the Electric Light Company for the right to use the system.

So much can be safely affirmed, that this light can be sold at a price which will make competition on the part of the gaslight companies impossible: 1. Because the total investment in plant to develop a given quantity of light is much less; 2. Because the depreciation of plant is much less; 3. Because the cost for labour employed is very much less than in gas-works; 4. Because the electric light companies will not have to make any dead investment in large areas of real estate; it is not even necessary to erect buildings specially to serve as stations, for the ordinary buildings, such as are used for different branches of manufacture will serve the purpose, and may be hired on rental. 5. Because the companies can sell electricity for two uses—for light at night and for power in the daytime. It has been ascertained by experiment that power can be supplied through this system from twenty-five horse-power down to 1-100th of a horse-power on the same mains that supply the light; and that elevators, printing presses, sewing machines, fans, pumps, &c., can be run by electricity from a central station far more economically than by any other means. A canvass of the city of New York has shown that the demand for small powers in private dwellings and minor industrial establishments will give occupation to the central stations in the lower part of the city for ten hours daily. This power can be supplied at such a profit to the companies as to more than cover the expense of running the stations for six hours longer in producing electric light. It is evident, therefore, that in a competition with gas the electric light possesses an enormous advantage.

THOMAS A. EDISON.

JOSEPH HENRY.

(CONCLUDED FROM PAGE 257.)

If Ohm's law had been known to Henry, with all of its consequences, when applied to his discovery of the exaltation of the electro-magnetism of iron, in connection with his discovery of the proper relations necessary between batteries and magnet to get the greatest electro-magnetic effects, his discoveries would appear dwarfed, though yet of excellent workmanship. But did he at this time, 1827 to 1832, know of Ohm's law? I infer that Henry arrived at his discoveries independently of such knowledge, and for two-fold reasons. First, Ohm's law was published as late as 1827, in Berlin, and was received almost contemptuously. Henry was unable to read German, and Ohm's papers were first published in English in 1841. Secondly, from the manner in which Henry worked at his problems and viewed his results, I conclude that he had no knowledge of Ohm's laws; else why should he have been astonished at the effects when his intensity magnet was connected with his intensity battery? Henry, now in possession of powerful magnets, began to work on another problem. He tried to do the reverse of what he had already done. His magnet was made by the action of the electric current, and he now tried to obtain an electric current from the magnet, and he succeeded. Henry and Faraday independently discovered the means of producing an electric current and spark from a magnet. Tyndall speaks of this experimental result as the "Mont Blanc of Faraday's own achievements." A few words now will place Henry in his proper and just relations to these important discoveries. All the information he had reeeived about Faraday's discovery was the account of Faraday's production of magneto-electricity by the sudden insertion of a magnet into a helix, and its sudden withdrawal therefrom. Henry's experiment is entirely different, and certainly was entirely original with him; but it is essentially identical with another of Faraday's of which Henry had no knowledge. Thus it appears that, although Henry cannot be placed on record as the *first* discoverer of the magneto-electric current, he stands alone as its *second* independent discoverer.

Henry's next discovery was that of the induction of a current upon itself, or of the extra current, as it is sometimes called. Here he anticipated Faraday by nearly two years and a half in the observation of the fundamental facts. Notwithstanding an explicit disclaimer of Faraday, the credit of this discovery has been generally given to the latter. This is accounted for by the fact that, although Henry anticipated others in his observations, he had not leisure to follow them up to their full explanation until after Faraday had completely unravelled their nature. In 1838, after his return from a first visit to Europe, Henry discovered an entirely new class of phenomena in electrical induction. He first showed that an induced current may excite a second induced current in a neighbouring closed conductor, that this last may induce a third current, and so on. These currents Henry styled currents of the first, second, third, &c., orders, and he showed that they alternate in their direction successively. He investigates the difference in these currents as they flow through different resistances. The same phenomena he tracks through the inductive sections of the discharge of the Leyden jar and of the frictional electrical machine, and shows how they differ from those produced by the voltaic battery. These researches are the most finished of Henry's investigations, and will ever be regarded as models of careful and thorough scientific work.

Henry had a versatile mind, and did not confine his attention to the study of electricity. His researches in molecular physics, though not extensive, are remarkable. Here his suggestions and methods have stimulated others to follow in the paths which he has pointed out. In 1839 Henry made a curious discovery as to the permeability of lead to mercury. He found mercury would even ascend a lead wire to the height of a yard in a few days. He even made what might be called syphons of lead, which would nearly empty a vessel of mercury by drawing the fluid over its sides. Subsequently, in 1845, with Mr. Cornelius, he proved that copper, when heated to the melting point of silver, would absorb the latter metal. In 1844 Henry was investigating the nature of the forces acting in liquid films. Studying the tenacity of the soap bubble film, although his experiments could only furnish approximate results, they showed that the molecular attraction of water for water is really several hundred pounds to the square inch, and probably equal to the attraction of ice for ice. Another of Henry's investigations, having a practical bearing, should be more widely known than it is. Among his duties as chairman of the United States lighthouse board was the testing of the various physical properties of the oils submitted to the Government for purchase. Fluidity was one of these properties for which it seemed most difficult to get reliable tests. Here he very ingeniously applied the theorem of Torricelli, which shows that equal quantities of all liquids of equal fluidity will flow out of an orifice in equal times. Henry found that with different oils the flow of equal quantities differed, the rapidity of flow of sperm oil exceeding that of lard oil in the ratio of 100 to 167. Alcohol proved to be less fluid than water. Henry took a deep interest in acoustics. His additions to this science were chiefly the results of experiments upon fog signals. He made extensive experiments with various sound-producing instruments, and eventually decided in favour of the steam syren fog-horn. He determined that these instruments send their sound farthest when tuned very near to the treble C, and he also showed the uselessness of applying reflectors to them. During eleven years Henry sought to advance the efficiency of our fog signals by experiments in all weathers. Many very puzzling facts were collected. Thus it was observed that a sound coming to a mariner against the wind would cease to be audible on the deck of his vessel, while it continued to be heard at the masthead. It was also observed that upon approaching a fog-horn from a distance the intensity of sound would gradually increase, then die down rapidly, become inaudible through a space of three or four miles, and perhaps not reappear until the vessel was within a mile of the instrument. These facts demanded explanations, and for a long time remained enigmas to Henry, till one day he met with a paper by Professor Stokes, in which the effect of an upper current in deflecting a wave of sound is fully explained. This hypothesis of Stokes Henry was able to apply to the solution of the problems in question.

Henry's services to the lighthouse board were of great value to the country. The fact that his investigations showed that lard oil heated to about 250 deg. Fahrenheit is superior in fluidity and illuminating power to sperm oil caused the substitution of the former for the latter. A dollar a gallon was saved, which amounts to about one hundred thousand dollars a year in favour of the Government. In light and heat Henry made several investigations which we must pass over. One, however, is so important that it cannot be omitted. I refer to his application of the thermopile in determining the distribution of heat on the optical images of distant objects. In a bold, and wonderful experiment, he sought to study the distribution of heat on the surface of the sun. In 1845, with Stephen Alexander, he formed an image of the sun, by means of a telescope, upon a screen. In this screen was cut an aperture, closed by the surface of a thermopile. By a motion of the telescope, any part of the image could be brought upon the pile. A solar spot being present, he clearly proved that it emitted less heat than the surrounding parts of the luminous disc. This method of research was shown to Secchi. On his return to Europe the latter made no small repute by extending these observations, using Henry's methods, but often, I fear, not giving full credit to the originator. But let that pass, for the bread which Henry cast upon

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the waters has returned to our own shores, thanks to the genius of our colleague Langley.

It is impossible to crowd into one brief hour the thoughts which were his occupation during more than half a century. I have at least endeavoured to exhibit the more important part of the labours of his life. What shall we think of them? Surely they are on as high a plane as those of any of his contemporaries, and show as much originality as theirs in their conception—as much skill in their execution. Yet it has been said that Henry was not a man of genius. As I have not been able to find that the philosophers who have the special charge of giving from time to time definitions of genius have been able to come to any satisfactory conclusion among themselves, I will leave their company, and, with your liberty, take my definition from a book which, if we accredit Thackeray, is one of the very best, if not the best, novel ever written in English. After listening to this I will allow you to form your own opinions as to whether Henry did or did not possess genius. "By genius I would understand that power, or rather those powers, of the mind which are capable of penetrating into all things within our reach and knowledge, and of distinguishing their essential differences. These are no other than invention and judgment, and they are both called by the collective name of genius, as they are of those gifts of nature which we bring with us into the world. Concerning each of which many seem to have fallen into very great errors; for by invention, I believe, is generally understood a creative faculty, which would indeed prove most romance writers to have the highest pretensions to it; whereas by invention is meant no more, and the word so signifies, than discovery in finding out; or, to explain it at large, a quick and sagacious penetration into the true essence of all the objects of our contemplation. This, I think, can rarely exist without the concomitancy of judgment, for how we can be said to have discovered the true essence of two things, without discovering their difference, seems to me hard to conceive. Now this last is the undisputed province of judgment; and yet some few men of wit have agreed with all the dull fellows in the world in representing these two to have seldom or never been the property of one and the same person." My own judgment, if of any value, would rank the ability of Henry—I do not say his achievements—a little below that of Faraday. Indeed their lives and their manners of working were strangely alike. Faraday was the son of a blacksmith. He once wrote: "I love a smith's shop and anything relating to smithery. My father was a smith." Henry's father plied a schooner on the Hudson. Each started in life with moral and benevolent habits, well-developed and healthy bodies, quick and accurate perceptions, calm judgment and self-reliance, tempered with morality and good manners—a good ground, surely, in which to plant the germs of the scientific life. Faraday was an apprentice to a bookbinder. Henry served in the same capacity under a blacksmith. Each, endowed with a lively imagination, was in his younger days found of romance and the drama; and, by a singular similarity of accidents, each had his attention turned to science by a book which chance threw in his way. This work in the case of Faraday was Mrs. Marcet's "Conversations on Chemistry," and the book which influenced Henry's career was Gregory's "Lectures on Experimental Philosophy, Astronomy and Chemistry." Of Mrs. Marcet's book Faraday thus writes:—"My Dear Friend,—Your subject interested me deeply every way; for Mrs. Marcet was a good friend to me, as she must have been to many of the human race. I entered the shop of a bookseller and bookbinder at the age of thirteen, in the year 1804, remaining there eight years, and during the chief part of the time bound books. Now it was in those books, in the hours of the week, that I found the beginning of my philosophy. There were two that especially helped me,—the Encyclopœdia Britannica, from which I gained my first notions of electricity, and Mrs. Marcet's 'Conversations on Chemistry,' which gave me my foundation in that science. Do not suppose that I was a very deep thinker, or was marked a precocious person. I was a burly, imaginative person, and could believe in the Arabian Nights as easily as in the Encyclopœdia. But facts were important to me and saved me. I could trust a fact and always cross-examined an assertion. So, when I questioned Mrs. Marcet's book by such little experiments as I could find means to perform, and found it true to the facts as I could understand them, I felt that I had got hold of an anchor in chemical knowledge, and clung fast to it. Thence my deep veneration for Mrs. Marcet—first, as one who had conferred great personal good pleasure on me; and then as one able to convey the truth and principle of those boundless fields of knowledge which concern natural things to the young, untaught and inquiring mind. You may imagine my delight when I came to know Mrs. Marcet personally; how often have I cast my thoughts backward, delighting to connect the past and the present; how often, when sending her a paper as a thank-offering, I thought of my first instructress; and such thoughts will remain with me."

Henry wrote on the inside of the cover of Gregory's work the following words:—"This book, although by no means a profound work, has, under Providence, exerted a remarkable influence on my life. It accidentally fell into my hands when I was about sixteen years old, and was the first book I ever read with attention. It opened to me a new world of thought and enjoyment; invested things before almost unnoticed with the highest interest; fixed my mind on the study of nature, and caused me to resolve at the time of reading it that I would immediately begin to devote my life to the acquisition of knowledge.—J. H." Each of these philosophers worked with simple instruments, mostly constructed by his own hands, and by methods so direct that he appeared to have an almost intuitive perception into the workings of nature; and each gave great care to the composition of his writings, sending his discoveries into the world clothed in simple and elegant English. Finally, each loved science more than money, and his Creator more than either. There was sympathy between these men; and Henry loved to dwell on the hours that he and Bach spent in Faraday's society. I shall never forget Henry's account of his visit to King's College, London, where Faraday, Wheatstone, Daniell and he had met to try and evolve the electric spark from the thermopile. Each in turn attempted and failed. Then came Henry's turn. He succeeded, calling in the aid of his discovery of the effect of a long interpolar wire wrapped around a piece of soft iron. Faraday became as wild as a boy, and, jumping up, shouted, "Hurrah for the Yankee experiment." And Faraday and Wheatstone reciprocated the high estimation in which Henry held them. During a visit to England, not long before Wheatstone's death, he told me that Faraday and he had, after Henry's classical investigation of the induced currents of different orders, written a joint letter to the council of the Royal Society, urging that the Copley medal, "that laurel wreath of science," should be bestowed on Henry. On further consultation with members of the council, it was decided to defer the honour till it would come with greater *éclat*, when Henry had continued farther his researches in electricity. Henry's removal to Washington interrupted these investigations. Wheatstone promised to give me this letter to convey to Henry as an evidence of the high appreciation which Faraday and he had for Henry's genius, but Wheatstone's untimely death prevented this. Both Faraday and he gave much thought to the philosophy of education, and in the main their ideas agreed. I may in this connection be excused from reading abstracts from a letter from Henry soon after he had received the news I had given my son his name. After a playful discussion of the name Joseph, Jo and Josey, he says—what may be news to most of you: "I did not object to Henry as a first name; although I have been sorry that my grandfather, in coming from Scotland to this country substituted it for Hendrie, a much less common, and, therefore, distinctive name." He then proceeds: "I hope that both his body and mind will be developed by proper training and instruction, that he may become an efficient, wise and good man. I say efficient and wise, because these two characteristics are not always united in the same person. Indeed, most of the inefficiency of the world is due to their separation. Wisdom may know what ought to be done, but it requires the aid of efficiency to accomplish the desired object. I hope that in the education of your son due attention may not only be given to the proper development of both these faculties, but also they will be cultivated in the order of nature; that is, doing before thinking; art before science. By inverting this order much injury is frequently done to a child, especially in the case of the only son of a widowed mother, in which a precocious boy becomes an insignificant man. On examination in such a case it will generally be found that the boy has never been drilled into expertness in the art of language, of arithmetic, or of spelling, of attention, perseverance and order: or, in other words, of the habits of an active and efficient life."

Henry was a man of extensive reading, and often surprised his friends by the extent and accuracy of his information, and by the original manner in which he brought his knowledge before them. Not only was he well versed in those subjects in which one might naturally suppose him proficient, but in departments of knowledge entirely distinct from that in which he gained his reputation as an original thinker. Although without a musical ear, he had a nice feeling for the movement of a poem, and was fond of drawing from his retentive memory poetic quotations apt to the occasion. He was a diligent student of mental philosophy, and also took a lively interest in the progress of biological science, especially in following the recent generalisation of Darwin; while the astonishing development of modern research in tracking the history of prehistoric man had for him a peculiar fascination. Yet with all his learning, reputation, and influence, Henry was as modest as he was pure. One day, on opening Henry's copy of "Young's Lectures on Natural Philosophy"—a book which he has studied more than any other work of science—I read on the fly-leaf, written in his own hand, these words.

"In Nature's infinite book of secrecy
A little I can read."—*Shakespeare.*

And did he not read a little "in Nature's infinite book of secrecy?" And did he not read that little well? May we all read our little in that book as modestly and as reverently as did Joseph Henry.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Oct. 20.		Business Done Week Ending Oct. 20. Highest.	Lowest.
Anglo-American Ordinary	63¼,	½	64⅛	62¾
Do. "B"	94,	½	95	94½
Do. "A"	33½,	⅜	34½	33⅜
Brazilian	10⅛,	¼	10¼	10
Cuba	8¾,	9¼	9¼	9⅛
Do. Ten per Cent. Pref.	16⅛,	¾	16⅜	16⅜
Direct Spanish	1¾,	2¼	2⅛	2 1-16
Do. Ten per Cent. Preference	11⅞,	12¼	12	12
Direct United States	12⅝,	⅞	12⅞	12⅝
Eastern	9⅞,	10	10	9¾
Do. Six per Cent. Debenture	103,	106	103½	104
Do. Five per Ct. do. 1899	103,	105	—	—
Do. Six p Ct. Pref	12⅛,	¾	12⅜	12⅛
Eastern Extension	10⅛,	¼	10⅜	10⅛
Do. Six per Ct. Deb	108,	111	110	110
German Union	9¾,	10¼	9 15-16	9⅞
Globe Telegraph & Trust	6¾,	7	7	6⅞
Do. Six p Ct. Preference	12 3-16,	5-16	12⅜	12⅛
Great Northern	9⅞,	10⅛	10⅛	10
Indo-European	24½,	25½	25¼	25¼
Mediterranean Extension	2⅝,	3¼	2 15-16	2¾
Do. Eight p Cent. Pref	10¾,	11	10¾	10¾
Reuter's	10½,	11½	11	10⅝
Submarine	245,	250	251	248
West India and Panama	1 5-16,	7-16	1⅜	1¼
Do. Six per Cent. 1st Preference	6⅝,	⅞	6⅞	6¾
Western and Brazilian	8,	¼	8 5-16	7¾
West. Union 7 p. Ct. 1st Mt.	120,	125	—	—
Do. Six per Ct. Sterg.	103,	106	—	—

TRAFFIC RECEIPTS FOR SEPTEMBER, 1880.

Companies.	Sept., 1880.	Sept., 1879.	Increase.	Decrse.
Cuba Submarine Company	1,800 estd.	3,314	—	1,514
Direct Spanish Telegraph Company	1,538	1,121	417	—
Eastern Telegraph Company	43,717	39,369	4,348	—
Eastern Extension Telegraph Company	28,771	26,980	1,791	—
Great Northern Telegraph Company	22,320	—	—	—

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	——	Victoria Docks.
Henley's	ss Caroline	526	70	——	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	——	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	St. Pierre.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Malta.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	——
Telegraph Construction	twin screw Scotia..	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard 'Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	——	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

ABSTRACTS OF SPECIFICATIONS.

—o—

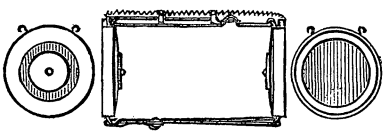
[*We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts*—Ed. *E.*]

671. Electric Telegraph for Railway Trains, *G. Dalström.—Dated 16th February*, 1880. 6*d*.

This consists in arranging telegraph wires along lines of railway and in connection with trains, in such manner as by apparatus to place each running train in uninterrupted communication with the various stations as also with every other train on the same line. Contact is made from one of the carriages with a light roll of metal, so arranged that the line wire constantly rests upon it.

899. Combined Galvanic Batteries and Medicated Pads for the Cure of Bodily Diseases, *A. M. Clark.—Dated 1st March*, 1880.—(*A communication*). 6*d*.

This consits in the combination of a galvanic battery formed of plates of zinc, felt, and copper, and a medicated pad, so that a circuit of galvanic electricity may be incited by moisture absorbed from the patient's body, while at the same time the patient receives benefit from the medicaments



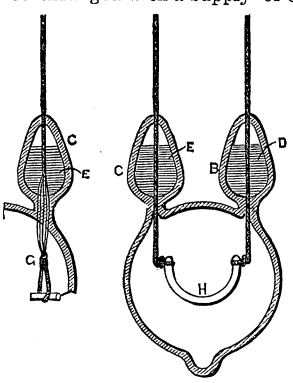
contained in the pad; also in the combination of a spiral conduction wire with two batteries and pads, so that the current of electricity will pass through both batteries and patient's body in the same circuit.

941. Telephonic Apparatus, *R. H. Courtenay.—Dated 3rd March*, 1880.—(*Not proceeded with.*) 2*d*.

In preference to carbon as now used in telephonic transmitting, various carbonates or other suitable salts of metals, and the metals also in a finely divided state, and also an alloy of metals of variable electrical resistance, are taken and heated in such a manner as to be easily mixed with water or other fluid and forming a compound metallic substance easily moulded to the required size and form.

925. Electric Lamps, *J. H. Guest.—Dated 2nd March*, 1880. 6*d*.

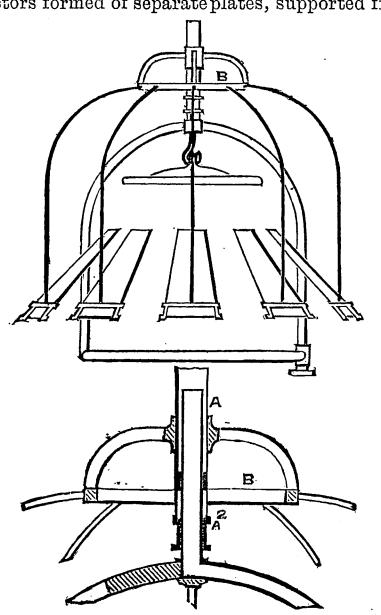
Two or more fine wires are twisted together and passed through the glass; the glass is melted so as to flow in between the wires, and thus prevent the passage of air, and the wires being in a twisted form yield as they expand, and hence the glass is not cracked. The bulb contains the carbon H. The cups B and C surround the conductors G, mercury in D and E forms a seat. In another form of the lamp a side chamber (also air tight) is arranged with a supply of carbons.



In this case the carbon is held in two loops, and the opening of the reservoir chamber is so made that only one carbon can slide out at a time into the loops. [We doubt the practical value of this form.—Ed. *E.*]

962. Lamps, *D. Hynd.—Dated 5th March*, 1880. 6*d*.

The essential features of this lamp are the reflectors formed of separate plates, supported from



above, over the jets or burners, and having a space between them, and the adjustability of the burners to a greater or less distance from the reflectors. A is the suspending tube. B is a ring for carrying the reflectors. A^2 is the gas-tight stuffing-box.

1049. Magneto-electric Brakes, &c., *C. Groombridge.—Dated 10th March*, 1880.—(*Not proceeded with*). 2*d*.

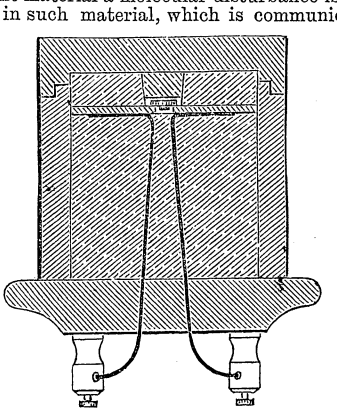
A number of electro-magnets are arranged in a bearing between two pairs of wheels, and their poles rest upon the face of the rails which form the armature of the magnets.

1081. Telephonic Apparatus, *F. H. W. Higgins.—Dated 12th March*, 1880.—(*Not proceeded with.*) 2*d*.

The transmitter consists of a diaphragm, to the centre of which is attached a spindle passing through a rod of carbon, the ends of which rest on two blocks of carbon between the rod and the diaphragm. The rod is pressed inwards and outwards by two spiral springs on the spindle, which has nuts to adjust the pressure of the springs. A Bell telephone is used as the receiver, the vibration of which is increased by increasing the permanent magnetic stress upon the diaphragm, and to prevent extra tones the diaphragm is made of two iron plates cemented together.

2418. Transmitters for Telephones, &c., *R. M. Lockwood and S. H. Bartlett.—Dated 15th June*, 1880.—(*Complete.*) 6*d*.

A microphone provided with transmitting wires is supported and embedded in cork or other non-resonant material, so that when sound waves are directed against the outer surface of the non-resonant material a molecular disturbance is produced in such material, which is communicated



to the microphone, and causes a similar disturbance therein, and the original sound modified thereby as a manifestation of force is transmitted through the microphone to the wires, and is reproduced at other portions of the circuit in any suitable receiver.

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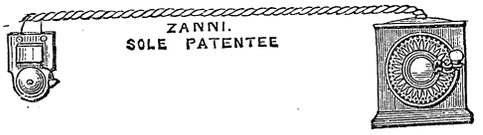
ZANNI  & CO.,

47, HOLBORN VIADUCT, E.C.,
(OPPOSITE THE CITY TEMPLE),

MANUFACTURERS OF ZANNI'S PATENT DYNAMO-ELECTRIC MACHINE,

The Cheapest in the Market.

MAGNETIC BELLS.—No Battery required. Satisfactory working guaranteed for five years.
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Ages at Entry.	NUMBER OF PREMIUMS PAID.					
	Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	——	——	787 10 0	517 0 0	310 10 0	137 10 0

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SLIP

CYMNER COLLIERY.—Arrangements have been made to light the yard and heapstead with the electric light.

JARROW.—A mild agitation is filling Jarrow whether the new market shall be lighted by means of the electric light.

WOOLWICH.—The "Brush" Electric Light has been introduced into the Royal Laboratory. Sixteen lamps are in use.

PROGRESS.—Leicester, Liverpool, Nottingham, and Over Darwen have obtained borrowing powers for the production and supply of the electric light.

INDO-EUROPEAN TELEGRAPH COMPANY.—The Directors have declared an interim dividend for the half year ending 30th June last, payable on and after Nov. 1 next.

MEMBERS OF THE SOCIETY OF TELEGRAPH ENGINEERS.—The next meeting, the particulars of which we give below, is to be held at Broad-sanctuary, not at Great George-street.

ELECTRIC LIGHT AT SHEPTON MALLET.—The Anglo-Bavarian Brewery Co. propose to adopt the electric light as a means of illuminating some parts of their extensive premises.

DESTRUCTION OF LAND LINES BY BASUTOS.—Communication between Durban and the Cape Colony is said to be interrupted, owing to the wires having been broken by the rebellious Basutos.

LA LAMPE-SOLEIL.—A new electric lamp is announced from Brussels and spoken of very favourably. Its chief feature appears to be that the arc is seen from below and is not obscured by the bougies.

THE ELECTRIC LIGHT IN COLLIERIES.—Mr. W. H. Preece, in a letter to *The Times* of Oct. 28, fully corroborates our recent remarks (*Electrician*, Oct. 2) on this subject, and, in fact, adduces the same reasons as we did against the use of electricity in fiery mines.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—The Board has resolved upon the payment of an interim dividend of 2s. per share, being at the rate of 5 per cent. per annum for the quarter ended 30th September, 1880, such dividend to be payable on and after the 16th November next.

THE SOCIETY OF TELEGRAPH ENGINEERS.—The first meeting after the recess will be held on Nov. 10th in the rooms of the Society, 4, Broad-sanctuary, when the Ronald's Library will be opened. The President will hold a reception, to which invitations have been issued to all our chief scientific celebrities, as well as to the members of the society.

BALLOONING AND THE ELECTRIC LIGHT.—Arrangements have been made by the Balloon Society of Great Britain for having the English and French balloons on view at the Royal Aquarium, Westminster, and, further, delivery there of a series of lectures in connection with ballooning and the lighting of large surfaces by means of the electric light.

PROFESSOR GRAHAM BELL.—*La Nature*, speaking of an interview one of its contributors has had with the illustrious inventor is warm in its praises of his conscientious and indefatigable industry. The amount of calculation and painstaking labour bestowed upon the photopone, the written evidence of which was inspected by the interviewer is, says *La Nature*, quite astounding.

AN ELECTRIC HAMMER.—Messrs. Siemens and Halske, of Berlin, are said to have patented a hammer and rock borer propelled directly by electricity. It consists of a rod of iron or soft steel moving within the axes of three coils. A constant current in the middle coil magnetises the rod, and alternating currents through the other coils cause it to be forced in and out with great rapidity.

THE "CAPE TOWN TELEGRAPH" AND THE OFFICIALS.—The *Pall Mall Gazette* complains of what it describes as "the flagrant dishonesty" of the Cape Town officials in withholding or manipulating information with regard to the Basuto war. Telegraphic intelligence, it appears, reaches this country from private sources giving details with which the Cape authorities are, but profess not to be, well acquainted; and in this way the Cape Government is endeavouring to bias for party purposes the news sent to England.

"THE JOURNAL OF GAS LIGHTING".—Our contemporary shows its fear of electric-light competition by its words. It denounces in good set terms the electric light from week to week, and wilfully closes its eyes to facts. There is no part of the civilised world which is not investigating the claims of electricity, and it is well known that most of the electric-light engineers are "full of orders." We offered—with great humility, it is true—a little advice to the gas companies two years ago, and we cannot do better than offer it again—therefore we say, make friends with the competitor.

GLASGOW.—ELECTRIC LIGHT EXHIBITION FOOTBALL MATCH.—The important match between players living north and south of the river took place at Burnbank on Monday night by aid of the electric light, which was supplied by the committee of the Philosophical Society's Gas Exhibition. The ground was illuminated by thirteen electric lights placed on elevated positions equi-distant, with extra powerful new patent reflectors, to diffuse the rays; one light alone, supplied by the Anglo-American Electric Light Company, was equal to 56,000 candles, and the general effect was very fine.

A NEW COMPANY.—The Swansea Telephonic Exchange Company (Limited), capital £5,000, in shares of £10, is formed for the manufacture of telephones, telephonic, and telegraphic instruments of all descriptions, wire insulators, poles, and batteries; and to establish and carry on the business of a telephonic exchange in all its branches. The subscribers (who take one share each) are:—G. S. Davies, Swansea, solicitor; H. J. Goss, Swansea, accountant; C. Fulton, Swansea, merchant; J. Legg, Swansea, telegraph engineer; B. Evans, Swansea, draper; T. H. Davies, Swansea, auctioneer; J. Roberts, Swansea, engineer.

ELECTRIC RAILWAYS.—In point of economy the American electric locomotive is expected to be an improvement on the existing steam locomotive. The cost of the former is estimated at only £600. In connection with this subject of electric propulsion, which has risen into some prominence of late, it is interesting to find that as early as 1834 it was suggested by an English inventor. On March 1 of that year a patent was taken out by Mr. Henry Pinkus for a "dynamic traveller," intended to propel vessels and carriages on canals, railways, and common roads, by means of magnets and electricity, as well as by pneumatic power.—*Design and Work.*

A NEW KIND OF ELECTROPHORUS.—Mr. Mitchinsen, a recent traveller in Africa, informs the *Lancet* that having had occasion to cowhide a nigger he observed that sparks were emitted from the victim's body at every blow. Strange to say the natives appeared quite accustomed to these phenomena. Cowhiding and electricity we had thought were products of civilisation; but it seems we were

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mistaken. Surely our stalwart criminals are not to be outdone by their coloured brethren in Africa. We all know that the cat is highly positive, and it may be confidently assumed that the convict is not less negative. Will somebody take observations at Newgate on the next thrashing day?

Congress of Electricians.—We are glad to find that although we in England have practically arrived at a period of stagnation, our neighbours are not yet in a somnolent state, and again take the initiative in matters electrical. According to an official announcement of Tuesday, an International Congress of Electricians will assemble at Paris on the 15th of September next year. At the same time it was announced that the Congress will be preceded by an international exhibition of electrical apparatus, to be held from the 1st to the 13th *August*. We sincerely trust the announcement as published is incorrect as to date, or that the time of the exhibition will be altered. The exhibition should be opened just before, during, and for a short time after the Congress sits. Will our friends in Paris consider the question?

Animal Electricity.—The inconvenient young lady whom the newspapers have lately discovered administering electric shocks to everybody who shakes hands with her is not an original phenomenon. To say nothing of the Canadians who habitually lighted the gas with their fingers' ends in quite modern times, Virgil tells us that the hair of Ascanius emitted a harmless flame, and Servius Tullius is known to have shot sparks out of his locks at the precocious age of seven. A more exact counterpart of our female cotemporary, however, lived in Verona about a couple of centuries ago. Cassandra Buri was unable to sleep in linen sheets because of the fire emitted from her body on getting into bed. Such were the crackling and blazing that her maids often fancied they had dropped live cinders out of the warming pan into the bed. This is the dull season.

The Fire at the Manchester Telegraph Office.—The extraordinary promptitude with which full communication was restored both from and to Manchester on this occasion is deserving of special notice. No fewer than 257 circuits were completely disabled, and a considerable amount of working apparatus shared the same fate; yet in twenty-four hours the whole of the lines were working as usual. No notice of delay was issued to the public, and indeed very little delay took place, supplementary and other lines being pressed into the service while repairs were going on. Plant and apparatus were despatched from neighbouring telegraph centres with the utmost speed; and thanks to the courage of the staff on duty at the time of the outbreak, and the energy of the engineering department immediately afterwards very little inconvenience indeed has been felt by the public.

The Action of the Photophone.—At Paris some doubts have already arisen in scientific circles as to the true explanation of the action of the photophone, and a correspondent of *L'Electricité*, M. Dujardin, roundly affirms that the effects produced are due to the transmission of heat accompanying the light. *L'Electricité* itself appears to share this view, for it points out that the luminous rays cannot strike the vibrating disc without producing warmth and consequently dilatation, resulting in sounds in (we quote *L'Electricité's* own words) "la même manière que le téléphone calorifique de M. Preece." The telephone here referred to is that described by Mr. Preece in a paper laid before the Royal Society in April last [*Proceedings Royal Soc.* 204, 1880], entitled, "On the Thermal Effects of Electrical Currents." It will be remembered that to a disc of iron was attached a fine platinum wire through which passed the current regulated by a microphone transmitter. With a power of six bichromate cells, Mr. Preece found that the action of the transmitter was followed by thermal changes in the wire with such extreme rapidity and exactitude that the disc attached to it would reproduce articulate sounds. [See *Electrician* June 5, 1880.] The opinion of *L'Electricité* would therefore appear to be that the luminous ray of the photophone transmitter acts upon the receiving disc of mica much in the same way as does Mr. Preece's platinum wire. In a separate article on the same subject our contemporary calls attention to the action of the Radiometer and puts forward an explanation which, it thinks, will serve also for the photophone.

Association of Gas Managers.—We like to obtain as complete a record as possible of opinions adverse or otherwise relating to electricity. Hence we note a few of the remarks made by Mr. R. L. Carlow, President of the West of Scotland Association of Gas Managers, at the meeting held on the 1st of October. "Gas," he said, "has many competitors, from the powerful electric light down to the halfpenny dip." Paraffin, in his opinion, is a far more dangerous rival than electricity. "Permit me," he said, "to draw your attention for a minute or two longer to the subject of electricity, which at present occupies so much of public attention. After watching the various phases of this question within the past two years—for that really is the period since it came to be regarded as a formidable rival of gas in the domain of public and domestic lighting—I am forced to the conclusion that if ever gas is compelled to play 'second fiddle,' it will not be to electricity. At this time of day it is useless to indulge in idle regrets that the scare caused by the announcement of Mr. Edison's discovery should have been productive of so much damage to gas stocks; but if that scare caused the unwary and nervous to smart, it had a beneficial influence upon the manufacture of gas, and its proper distribution and consumption. Inventors endeavoured to devise means whereby gas could be better and more economically consumed, and the result has been a decided victory in favour of gas. Unquestionably, if the desire is to illuminate a large space, and if an unsteady light and the greater expense of production do not form important factors in the calculation, electricity is a useful illuminant, but in no other circumstances. Hitherto it has been found impossible so to divide electricity as to produce, in our rooms and in our workshops, a multiplication of small lights, and it has been found equally difficult to store the subtle fluid in such quantities as to be of any practical value. While for the purpose of making a show, or, as in some instances, when it is used where careful discrimination of colour is necessary, electricity may be adopted, yet in the extensive field of domestic lighting gas stands unrivalled." In comparison with this let us quote the following from a letter from a well-known phycist of Newcastle-on-Tyne. "The expression to which I gave utterance at the conclusion of Mr. Swan's lecture on the present position of electric lighting in reply to a gentleman who asked my opinion respecting the lecture was, 'It was the most dangerous lecture to which I ever listened.' The gentleman looked at me in surprise, and asked me what I meant. My reply was 'Dangerous to the gas companies.'" And, again, another quotation from a letter by Sir W. G. Armstrong:—"Lighting by electric incandescence, as exemplified by Mr. Swan's experiments, is quite a different thing, and I have sufficient faith in the success of his method to induce me to make an immediate trial of it for the partial lighting of this house."

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ELECTRIC LIGHTING.*

Almost two years ago I had the honour of delivering a lecture in this place on Electric Light. To-night I have undertaken to report the progress which has been made since then in connection with the subject. At the time of my last lecture the public mind was greatly perturbed by the question whether or not gas lighting was about to be superseded by electric lighting. It was generally believed that a revolution-working discovery had been made, and you may remember, as a consequence, gas stock was much depressed in value. After a while, when the supposed wonderful discovery dwindled and paled in the daylight of scientific examination, the panic subsided, and then the current of feeling drove the other way, and in place of the hasty credulity which at first took possession of the public mind, there is now, I think, an equally unreasonable *unbelief* in the possibilities of electric lighting—the idea now widely prevailing that electric light, as a substitute for gas, is after all a delusion.

[A brief resumé of the *general principles* was here given, and the development of the dynamo-machine shown.]

On the whole *the cost of producing electricity by mechanical means has been diminished.*

It is practicable to develop 1 horse-power by the combustion of 2lb. of coal per hour, and to produce with this amount of motive power a current of electricity sufficient to give a light of over 1,000 standard candles; that is to say, we can maintain for one hour an electric light more than equal to 1,000 standard candles, or 66 large gas-burners, by the combustion of 2lb. of coal. That is a much more economical result than can be obtained by the voltaic battery or any other means of generating an electric current at present known. [Reference was made to the voltaic cell, and the question of storage was discussed as exemplified in the secondary battery of M. Planté.] M. Planté was, I believe, the first to put the idea of a secondary battery into practice. The secondary battery of M. Planté consists of plates of lead placed opposite each other and very near together, but not touching. Here is a Planté cell. It consists simply of two pieces of sheet lead rolled up together, and separated by the space of about one-eighth of an inch. You observe that in this combination we have two plates of the same metal, viz., *lead;* and in this respect the combination differs from an ordinary voltaic battery, inasmuch as the very essence—so to speak—of the voltaic battery is the dissimilarity of the two plates which in part constitute it. It is zinc and copper, or zinc and platinum, or some dissimilar combination of that sort that we are all familiar with as characteristic of the voltaic battery. Here, in the secondary battery, the two plates are alike, therefore of themselves they cannot generate a current of electricity like the ordinary voltaic battery. But if these two lead plates are for a time connected by wires with a generator of electricity, no matter of what kind (it may be a dynamo-electric machine which supplies the primary current), one of the lead plates is changed on its surface—it becomes oxidised—and after undergoing this change, it is, when detached from the generator, in such a condition as to be able to give out, at any future time, a current of electricity on its own account; and when the charge has been expended the plates are, like an empty gasometer, just in the same condition they were before receiving the charge, and ready to be charged afresh. The secondary battery is, therefore, an instrument of very great interest at the present moment, and it is much to be hoped that it may be improved, because, in the simple form which I have described, it does not quite do all that would be required of a secondary battery, applied as a store of electricity on a large scale for extensive practical electric lighting. I have here a modified form of a secondary battery, which, if it does not give us all that could be desired, makes a very considerable contribution towards it. This battery was charged this morning; before being charged it was nearly inert. I will join the poles together by this platinum wire, and if the charge has been retained the wire will become hot. [The wire is, you see, white hot.] The want of a means of storing electricity is a newly felt want; as yet it cannot be said to have been fully supplied, but, as I have shown you, it has been supplied to a certain extent, and research is still busy at work seeking its complete fulfilment. There can be no doubt that what is wanted will be found, and with the perfecting of the secondary battery that great objection to electric lighting—that you cannot store the power which produces it as you can store gas—will be completely met.

[The thermopile was here briefly referred to.]

All the various means of producing light by electricity that can make any pretention to practicability are divisible into two classes, namely:—

1st. Lighting by the electric arc.
2nd. Lighting by incandescence.

In lighting by the electric arc, there is a break or gap in the circuit which has to be bridged over by a sort of electric flame. In lighting by incandescence there is no break or gap at the point where light is produced, but a thin highly infusible and badly conducting solid substance is there interposed which becomes white hot, and emits a light, bright in proportion to the degree of heat produced in it.

Now, to fix in your mind precisely what I am talking about, I will first show you what I mean by the electric arc. This will enable you more easily to follow my remarks on the question of electric lighting by this method.

Here is an enlarged view of the electric arc—here are the two carbon points, and here—between them—is formed the electric arc.

A powerful electric current, produced by a gas engine and dynamo-electric machine, is supplied to these two pencils of carbon through thick copper conducting wires, and you see that a stream of flame is flowing or rushing between them. If the points are too much separated the light is lessened; by increasing the air-space between the points resistance to the passage of the current is increased, and the current is consequently diminished, and when this diminution of current passes a certain limit the light is lessened. On the other hand, when the points are made to approach too closely to each other, the light becomes less for the opposite reason.

A certain amount of difficulty or resistance must be offered to the passage of the current in order to produce light, and to get the best effect the resistance must neither be too much nor too little.

When the points are made to touch there is no longer the resistance of the air-space to be struggled through, the light consequently goes out.

Observe the alteration in the points; they burn away, and one faster than the other. Now, as the production of a steady light demands that the points should be maintained at a constant distance apart, it is evident that under the complicated conditions of the case, a nice regulation of the distance of the points to each other is a matter of extreme difficulty.

I will now ask for the current to be turned on to a lamp hung up aloft, in order that you may see how very nearly the difficulties of producing a steady arc light have been surmounted.

The particular lamp I am using for the purpose of my illustration is Crompton's lamp, of which here is a diagram. Properly regulated it feeds the pencils together almost continuously and with great precision.

That, then, ladies and gentlemen, is "par excellence" *The Electric Light.* That is the form and style of electric light that inventors have for the last forty years struggled and battled with difficulty upon difficulty to render serviceable to the wants of man.

From the nature of the electric arc light you will readily perceive that it is a kind of light not suited to the lighting of dwelling houses, nor shops, nor streets.

It does not lend itself kindly to division, nor extensive distribution. It will give you either a great deal of light or none.

For certain exceptional uses it is excellent. If you want a very brilliant illumination all centred in one focus, for a light-house, or signal, for example, or for a high-roofed railway station, or very large workshop, or open space, it is unquestionably the most economical and the best of all artificial lights.

It has already found for itself in England over 200 appropriate applications. Its use is continued and increased on the Thames embankment. It is used in the reading room of the British Museum; in the Picton Library, Liverpool; in a portion of the South Kensington Museum; at the Liverpool-street Railway Station; the Barrow Shipbuilding Works; the St. Enoch Railway Station, Glasgow; on the Promenade at Blackpool; and at the New Albert Docks, where, by means of Siemens's lamps, three miles of wharfs and quays are made almost as light by night as by day, and at a very moderate cost.

As an illustration of the economy of lighting by means of the electric arc under conditions suited to its use, I instance the case of the Alexandra Palace, where 2,000 gas lights, which consumed 26s. worth of gas per hour, are replaced by six of Mr. Crompton's lamps, giving a greater aggregate amount of light than the 2,000 gas burners, at a cost of 6s. per hour. In some instances the economy of the electric arc light is greater by half than in the case I have mentioned. Not only is it economical in such a case as that of the Alexandra Palace, but it produces an effect of general illumination overhead as well as upon the ground not producible by any other means.

But the interest which attaches to electric arc lighting is much lessened by the fact that the purposes to which that mode of lighting is suited are exceptional. We do not, as a rule, want the light of 1,000 candles or more all in one place. What we do generally want is a number of small and steady lights, spread about in different rooms, and in different prrts of those rooms. For electric light of this description we must search in another direction.

I said that there is *another way* of producing electric light; namely by *incandescence.*

Lighting by incandescence is a branch of the subject which has a special charm for me, because I have bestowed upon it much thought and labour; and it is I believe *the* branch which will yield the largest crop of fruit. Electric lighting by incandescence is just as simple as arc lighting is difficult; all that is required is a material which is not a very good conductor of electricity, highly infusible, and which can be formed into a wire or lamina, and is either non-combustible in air, or, if combustible, does not undergo change in a vacuum. There are, so far as I know, just two substances that possess, in any sufficient degree for the purpose in question, the qualities I have specified.

The two substances are: Platinum, or an alloy of platinum with iridium; and carbon. Platinum has the advantage over carbon that it is not combustible in air; it does not, like carbon, burn away if you make it white hot; but it is very inferior to carbon in the degree of heat it will bear without fusion; and for producing light by incandescence it is essential to economy that the incandescent material should be capable of enduring an extremely high temperature, because the amount of light emitted by an incandescent substance increases in a more rapid ratio than the temperature.

When, for example, you have a piece of platinum wire or carbon red hot, it emits almost no light, but double its temperature by sending a double quantity of current through it, and it will yield much more than twice the light it did before.

It is therefore evident that the hotter the incandescent material can be made the less the light will cost per unit of power expended.

Iridio-platinum, comparatively with other metals, may be called extremely infusible, but compared with carbon it is nowhere. Carbon has in fact resisted without fusion the very highest degree of heat brought to bear upon it, and what that degree of heat is I can hardly estimate, it is so enormous.

But carbon has been found so difficult to deal with on account of its ready combustibility (and some other troublesome properties which I will mention afterwards) that experimenters have bestowed much attention upon platinum and iridio-platinum as the incandescent material for electric lamps.

Mr. Edison was, I think, the last who attempted to utilise platinum in an electric lamp, and I think there can be no doubt that he obtained better results with platinum, and came nearer making a useful platinum lamp than any experimenter in the same track, who had gone before him.

Here is a view of Edison's platinum lamp.

This is the lamp of which so much was promised and expected in October, 1878, and which led, you remember, to the panic in gas shares. This lamp did not realise the hopes of the inventor.

(I will not rekindle Mr. Crompton's Electric Sun, because I hope presently to show you some small lamps, whose light would be absolutely drowned in that fierce radiance, as stars are by the light of day).

Whilst Mr. Edison was endeavouring to produce a useful incandescent

* Abstract of a Lecture, delivered by J. W. Swan, at the Literary and Philosophical Society, Newcastle-on-Tyne, October 20th, 1880.

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lamp by means of platinum, I was endeavouring to obtain the same end by means of carbon.

It had appeared to me for many years that if ever electric light was to become generally useful, it would, most probably, be by means by the incandescence of carbon. I had, long before the time to which I am referring, attempted to render this idea practicable.

As a matter of history, I will briefly describe an experiment which I tried about twenty years ago.

I had a number of pieces of paper and card of various forms and sizes buried in charcoal in a crucible. This crucible I sent to be heated white-hot in one of the pottery kilns belonging to Mr. Wallace, of Forth Banks. From the pieces of carbonised card which I thus obtained, I selected a long spiral, the ends of this I clipped between small blocks of carbon carried by uprights, and connected with conducting wires. A small glass shade was cemented over this mounted carbon spiral, and the air was exhausted by means of a very good air-pump, lent to me for the purpose of this experiment by the Rev. Robert Green, of Longhorsley. A good vacuum (according to the ideas that then prevailed) having been produced, I applied the wires of my battery (consisting of ten cells of Callan's modification of Groves's Battery) with great expectation of a brilliant result; instead of this, there was the most absolute negative presented to me, not a vestige of heat or light appeared in my long ringlet of carbonised paper. It was evident, and I immediately recognised the fact, that the electric current of the strength I was using would not go in sufficient quantity through so long a piece of carbon as I had taken. I therefore repeated the experiment with shorter carbon and a greater number of cells, and I obtained, under these altered circumstances, an extremely interesting result.

My carbon was in the form of an arch (this diagram will help my explanation), about one inch high and a quarter of an inch wide. The ends of the arch were held in small clamps, with square blocks of carbon.

The air pump having been worked, I had the pleasure of seeing that when contact with the battery of 40 or 50 cells was completed my carbonised paper arch became red hot, and it was evident that nothing more was wanted than a still stronger current to make it give out a brilliant light; but I had used up all the battery power at my disposal, and having reached this limit, I contented myself with watching the behaviour of the arch, the engrossing question being—how long will it endure?

I noticed that the inner part of the arch was hotter than the outer part, and that, perhaps in consequence of this, the arch became bent on one side. This bending gradually increased, until at last the arch had so far curled down that the top was on a level with the clamps, and on coming in contact with the sole of the lamp it broke in two, and the experiment collapsed.

That, I confidently believe, was the very first instance in which carbonised paper was ever used in the construction of an incandescent electric lamp.

I am now speaking of 20 years ago, and at that time the voltaic battery was the cheapest source of electricity known, and the means of producing high vacua were very much less perfect than they are now.

I laid my electric light experiments aside until about three years ago, when two things concurred to lead me to pursue the subject afresh.

The discovery of the dynamo-electric machine had entirely altered the position of the question of electric lighting, shifting it out of the region of things scientifically interesting into that of things practically useful.

The Sprengel air-pump, too, had been invented, and with its invention we had been provided with a means of producing much higher vacua than could be produced by the old form of air-pump.

Mr. Crookes' radiometer experiments had shown us what a really high vacuum was, and how to produce it.

Mr. Stearn, of Birkenhead, an ardent scientific amateur, was so attracted by the extraordinary results Mr. Crookes had obtained by means of high vacua as to go with great enthusiasm into the same line of experiment, and he soon acquired such a knowledge of the Sprengel pump and such expertness in its manipulation as perhaps was only equalled by Mr. Crookes himself.

I had the good fortune to make Mr. Stearn's acquaintance, and that was the other one of the determining causes of my second attempt to solve the problem of electric lighting by the incandescence of carbon.

In the interval between the 1st and 2nd periods I have mentioned many attempts had been made by various experimenters to render practicable incandescent carbon lamps, but none were entirely successful.

Here is represented a variety of the most notable of these attempts. Some are vacuum lamps, and some have air admitted. Sawyer and Mann's lamp is filled with nitrogen. When the incandescent carbon is in air it burns away, and must consequently be renewed just as a candle must be renewed; it must also be thicker than would be necessary in a vacuum, and, being thicker, it requires a proportionally greater current to render it incandescent; both these circumstances are obviously against economy.

The Andrè lamp is one of the best of this type. In this the supply of air is limited; still, this lamp and all those lamps are lacking in simplicity and n economy.

In all the various attempts to utilise the principle of the incandescence of carbon in vacuo two great difficulties had stood in the way, and baffled every attempt to overcome them. One was *the rapid wearing away and consequent breaking of the incandescent carbon;* and the other *the obscuration of the lamp by a kind of black smoke.* So uniformly did these phenomena present themselves that the idea was propounded and generally accepted that the blackening of the lamp globes was due to volatilisation of the carbon under the action of the enormous heat to which it was subjected.

In Fontaine's work on electric light this passage occurs at page 180.

"Attentive examination of incandescent carbons, through a strongly coloured glass, has shown that they are not uniformly brilliant. They present obscure spots indicative of non-homogenity, and the position of cracks, which rapidly disintegrate the carbon. The vacuum never being perfect in the receivers the first carbon is in greater part consumed. It would appear that, consequently upon the little oxygen contained in the lamp being transformed into carbonic acid and carbonic oxide, the carbon should be preserved indefinitely. But there is *then* produced a kind of *evaporation* which continues to slowly destroy the incandescent rods. This evaporation is, besides, *clearly proved by a pulverulent deposit of sublimed carbon, that we have found on the interior surface of the bells, on the several interior parts, rods, contacts, hammers, &c.*"

If this idea of the volatilisation of carbon were founded in fact, any further attempt to render incandescent carbon lamps *durable* by means of a vacuum were *mere waste of time*, and durable they *must* be if they were to be of any practical value.

Fortunately I did not accept as conclusive the experiments which seemed to show that carbon was volatile, and that the blackening of globes of incandescent carbon lamps was an inevitable result of the carbon being very highly heated. I knew that the conditions under which, without exception, all previous experiments had been tried, were such as did not allow to be formed anything approaching a perfect vacuum within the lamp. Screw fittings had invariably been employed to close the mouth of the lamp, and the ordinary air-pump to exhaust the air. Under such circumstances it was certain that a considerable residuum of air would be contained within it, and also that it would leak. Then, there had never been any thought given to the gas occluded in the carbon itself, and which, when the carbon became hot by the passage of the current through it, would be evolved; nor had sufficient care been taken *to make the resistance, at the points of fixture of the carbon, less than in the carbon to be heated to incandescence.*

It was evident to me that before any definite conclusion could be arrived at as to the question of the volatility of carbon, the cause of the blackening of the globes, and the wearing away of the incandescent rods, *we must first try the experiment of heating the carbon to a state of extreme incandescence in a thoroughly good vacuum* (such as Mr. Crookes had taught us how to procure), *and under more favourable conditions as to the contact between the incandescent carbon and the conductors supporting it than had hitherto obtained.*

Accordingly, in October, 1877, I sent to Mr. Stearn a number of carbons, made from carbonised cardboard, with the request that he would get them mounted for me in glass globes by a glass blower, and then exhaust the air as completely as possible. This delicate operation Mr. Stearn very kindly undertook, and very skilfully carried out.

In order to produce a good vacuum it was found necessary to heat the carbon to a very high degree by means of the electic current *during the process of exhaustion*, so as to expel the gas occluded by the carbon in its cold state, for, otherwise, however good the vacuum was before the carbon was heated, immediately the current passed and made it white hot, the vacuum was destroyed by the out-rush of the gas pent up in the carbon in its cold state. In order to make a good contact between the carbon and the clips supporting it, the ends of the carbon were thickened, and, in some of the early experiments, electrotyping and hard soldering of the ends of the carbons to platinum was resorted to.

I will not weary you, however, with details, but simply say that the prescribed conditions having been rigorously complied with, it was found, after many troublesome experiments, that *when the vacuum within the lamp globe was good, and the contact between the carbon and the conductor which supported it sufficent, there was no blackening of the globes, and no appreciable wasting away of the carbons.*

Thus was swept away a pernicious error, which, like a lying finger-post, proclaiming "No road this way," tended to bar progress along a good thoroughfare.

It only remained to perfect the details of the lamp, to find the best material from which to form the carbon, and to fix this material in the lamp in the best manner. These points, I think, I have now satisfactorily settled; and you see the result in the lamp before me on the table.

It is a very modest looking affair, but its performance goes beyond its appearance. The carbon is extremely thin—a mere hair—and how wonderfully strong and elastic it is I will endeavour to show you by means of the lantern.

This carbon, unlike the carbon spoken of by Fontaine in the extract I read to you, is quite homogeneous and almost flinty in hardness, and it becomes harder by the use in the lamp; the longer and the hotter it is heated the harder it becomes. What degree of hardness it will ultimately arrive at is an interesting question.

Here is a magnified view of the carbon ring in a state of incandescence. Observe how absolutely uniform in brightness it is; that proves it to be homogeneous, and foretells its durability.

Now I will show you how easily lamps of this kind are lighted, and how completely this form of electric light can be divided and distributed.

Is it not a pleasant light? It is not so white as the arc light, but yet a whiter light than gas. Colours are correctly seen by it as this picture shows. But the great merit of this light consists in its not being in contact with air, and, therefore, there cannot possibly be the slightest air pollution caused by it. The rooms in which this light is used will be as pure by night as by day.

It is essential to economy in lighting by incandescence that the incandescent carbon should be very thin. The carbon I use is not one-twentieth the thickness of the thinnest of the carbons formerly employed, and, therefore, one-twentieth of the current, costing one-twentieth the price, will produce in my thin carbon the same degree of luminosity as twenty times more current will produce in such carbons as were used in those ancient lamps.

You will notice that in my lamp leakage is very thoroughly guarded against. The wire which passes through the glass not only having the glass fused around it where the wire and globe meet—but in addition to this, the wire is coated with glass almost up to the carbon. In this way the vacuum is preserved very effectually.

You have, of course, all heard that after Mr. Edison abandoned his platinum lamp as impracticable, he invented a new lamp in which carbonised cardboard is used.

Here is a diagram of Mr. Edison's carbon lamp, with its horse-shoe of carbonised paper. It is in some respects like mine, but latterly I have given up the use of carbonised cardboard, and am now using a material as much better than carbonised cardboard as carbonised cardboard was better than the material previously used. In an article which appeared in the February number of *Scribner's Magazine*, authenticated by a letter from Mr. Edison in the same publication, it is stated that Mr. Edison was the first to use carbonised paper; that is incorrect. And this also occurs after a description of the Sprengel pump used in exhausting these lamps:—"Mr. Edison's use of carbon in such a vacuum is entirely new." Now, I daresay there are many here who will remember this little lamp, which I showed here two years ago in action. This lamp has exactly the same simplicity as my present lamp, being composed entirely of three substances,

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namely, glass, platinum, and carbon, and it was exhausted in precisely the same manner, and to the same degree, as that which Mr. Upton—no doubt in good faith but still in error—speaks of as "*entirely new.*"

I do not mention these things in any way to disparage Mr. Edison, for no one can esteem more highly his inventive genius than I do. I merely state these facts because I think it is right to do so in my own interest, and in the interest of true history.

The complete seclusion of the light in this lamp from contact with air suggests its adaptability to coal mine illumination, and I earnestly hope that this may prove to be one of its uses.

But the great purpose to which a lamp of this kind is applicable is the lighting of your houses. In view of such an application two all-important questions present themselves—one as to distribution, another as to cost.

Can this light be divided, distributed, and measured as gas is divided, distributed, and measured? And at what cost? It is quite impossible in a brief lecture to discuss these questions exhaustively, but as far as is possible, in a few words, I will answer them.

1st. Then, as to division and distribution, it has been asserted on very high authority that great loss necessarily attends the division of the electric light. To a certain extent this is true of lighting by the electric arc, but it is totally and absolutely erroneous of lighting by incandescence. *There is no loss in dividing the electric light produced by this means.* Faraday has stated the law of the case in these words: "An electric current which will heat one inch of wire *white hot*, will also heat to the same temperature 100 inches, or an infinite length of the same wire." There is no question of the truth of this. Now, as it is only necessary, in order to maintain a given current, to increase the force which produces it in the same proportion as you increase the resistance to its flow, it follows that the cost of raising to a certain degree of incandescence a longer or shorter length of carbon or of maintaining a 10 candle-light or 100 candle-light will be exactly proportional to the light produced. You may even contemplate on this principle the economical production of an electric light as small as a rushlight. A certain unit of light may be established in an indefinite number of places, with no greater aggregate expenditure of power than that directly and simply proportional to the number of lights.

With regard to distribution, I believe that it will prove to be practicable to light any large town—all Newcastle, for instance—by means of wires laid in the ground as gas pipes are laid, and all branching from one centre, and conveying the electric current to lamps like this.

The lamps now lighted are supplied by a current coming from generators working at the far end of Mosley-street (a quarter of a mile away), and it would be just as easy by using a more energetic current—a current as it were under higher pressure—to maintain these several miles away, and for this purpose the conductors need not be large, not so large certainly as to make the distribution of electric current more costly than the distribution of gas.

For supplying large towns with electric light, Mr. Edison proposes to have a number of centres for the supply of electric power, perhaps a quarter of a mile apart, whence wires would be sent out in every different direction, distributing the current to the houses round about. His plan of distribution is this. He proposes to send out bundles of main wires from each of the centres of supply, and from these main wires to branch as many small wires into the houses as there are lamps to be lighted, each branch wire proceeding from a main wire to the place where the lamp is situated, and from thence to a return main wire.

Now although this plan has the great merit of simplicity, I do not think it will answer, except for very short distances.

When a number of lamps are grouped together in that manner, it is necessary that the individual lamps should offer a very high resistance to the current, for if each lamp does not offer an extremely high resistance to the passage of the current there must be great waste, a large proportion of energy being in that case spent in heating the conducting wires, instead of the carbon in the lamps.

Mr. Edison accordingly proposes to make his lamps of a very high resistance; he proposes to use for the incandescent material a form of carbon which offers a higher resistance than simple carbon in its compact state; but if carbon pure and simple is used, then I submit it had better be in as stable and condensed a state as possible, because in process of use it tends to consolidate, and it is undesirable that any change should take place in the lamp during use.

The resistance offered by a filament of carbon in its best state for incandesceut lamps, as thin as it is safe to use in a lamp, and of a length sufficient to give say a light equal to one burner, or 10 standard candles (a unit of light which I think we must not go beyond in planning an extensive system of town lighting) will not offer so high a resistance as that which Mr. Edison has made the basis of his scheme of distribution.

With lamps of this resistance, the result would be that before many were bridged across from one main wire to another, as much or more work would be done in the conducting wire as in the lamp. The only way of avoiding this waste of energy, without abandoning the idea of small units of light, would be either to employ enormously thick conductors, or have a very limited area supplied from one works.

I think the difficulty is capable of being surmounted in this way:—Instead of grouping the lamps as Mr. Edison proposes, each lamp being as it were a loop or bridge between two mains, I propose to string them in series—10, 50, or perhaps 100 lamps being all interposed in one and the same line. In this way every lamp would *add* to the resistance of the line, instead of, as in Mr. Edison's plan, *diminishing* its resistance. The waste of energy in the conducting wire would thus be avoided.

A copper wire, less than $\frac{1}{8}$th of an inch thick, would supply current for one such series of, say from 10 to 100 lamps, at five miles distance, with a very small per centage of loss; while to supply at the same distance a corresponding series on Mr. Edison's plan would demand copper conductors of such thickness as would certainly make the plan far too expensive, or, if such thick conductor was not used, there would be an impracticably extravagant waste of energy in the wire. If even 50 per cent. of the energy were expended in the wire, the size of the conductor required to transmit the current, say even two miles, would be far too great.

There is no way of escape that I know of from this dilemma, viz., that either we must make our unit of light larger than necessary for a very great many purposes, and so give up the idea of extensive division and extensive distribution, or, in order to gain these points, we must group the lamps in the manner I have proposed.

There are, no doubt, difficulties in the carrying out of my plan, but none that are not easily surmountable. For example, if 20, 50, or 100 lights were in a series, a break in any part of the line would extinguish all the lights. This danger can be met in two ways:—

I would have only one lamp belonging to a given line in one house, so that the extinction of such a line of lights as we are contemplating would not be a very serious mishap; but I would make such a mishap extremely unlikely to occur, by placing along with each lamp an automatic circuit closer. This would so act as to bridge over the gap made by the accidental breaking or failure of a lamp, and so prevent the extinction of the rest of the lamps in the series, while a fresh lamp was put in the place of the broken one—a thing no more difficult, and probably not more costly, than the replacement of a broken gas burner chimney, or globe.

There is another difficulty occasioned by the variation of the current in proportion to the number of lamps in action.

What is required in this case is to maintain a uniform current in the line of lamps, whether 1 or 100 are alight. This can be accomplished by self-acting apparatus somewhat on the principle of the governor of the steam engine, and which would automatically raise or lower the potential or pressure by steps of 100ths, according to the number of lamps in use.

I have also considered the question of measuring the current, and, if time allowed, I could show you that that could be done as easily as the measuring of gas.

Similarly, all other practical difficulties arising out of this method of distribution can be met, and being met, we are at liberty to contemplate a great central works producing electricity by large steam engines, and distributing it by means of wires to a whole town, exactly as gas is now distributed by gasworks.

I have already referred to the cost of electric light produced on the arc principle, and shown that when the circumstances are favourable to the employment of that method it is much more economical than gaslight.

The economy of lighting by incandescence has not been exemplified by so many instances of actual practical use. One thing is, however, *quite clear*, and that is, that *electric lighting by incandescence is an economical process*—it will be less costly than gas lighting. That is conclusively demonstrated by the fact that the 1,000 feet of gas employed in working a gas engine to develop an electric current, and used in my lamps, will yield more light than 1,000 feet of gas consumed in the ordinary way in gas burners. This room is now lighted by twenty of my electric lamps, and to produce the current which feeds them 160 cubic feet of gas per hour are being burnt in a gas engine; before my lamps were kindled the room was lighted by 70 gas jets, consuming, I am told on good authority, 280 feet per hour. It is very evident that we have got more light out of the gas through the medium of electricity than was got from the larger quantity of gas which those burners consumed. Our conditions here are somewhat unfavourable to my light for a fair comparison, but from measurements carefully made, both of light produced and current required to produce it, I am warranted in saying that at least twice as much light will be produced by a certain quantity of gas used to generate an electric current employed in my lamps than would be obtained from this quantity of gas burnt in gas burners in the usual manner.

If that is so, then it is evident that when, instead of the motive power of gas, that of steam produced in the most economical manner is employed, this method of electric lighting will be very much less costly than gas lighting. I reckon that 40lbs. of coal employed in raising steam to generate electricity is capable of producing in my lamps the effect of 1,000 feet of gas burnt in gas burners in the ordinary manner.

The economical view of the question is therefore, in my opinion, very favourable to electric lighting, and I think fully warrants me in anticipating an extensive substitution of electric light for gas light.

The great difficulty which till now has completely blocked the way to any general use of electric light was *the difficulty of division. That difficulty is now completely overcome*, by the method of producing electric light by the incandescence of carbon in vacuo of which I have given you a practical demonstration to-night.

Now, ladies and gentlemen, if I have not exhausted my subject I certainly have exhausted your patience. I will weary you no more.

Eighty years ago science gave us enlarged means of turning night into day; since then not a little of our lifetime has been spent in gas-lit rooms, and it has been somewhat of a reproach to science that she has not provided us with this larger measure of light without at the same time imposing on us the necessity of breathing a vitiated atmosphere.

To-day, science vindicates herself: henceforth we may make the long nights of our northern winter bright without any such sacrifice.

SOCIETY OF ARTS.—The first meeting of the One Hundred and Twenty-Seventh Session of the Society is announced for the 17th November, when the Opening Address will be delivered by F. J. Bramwell, F.R.S., Chairman of the Council. Before Christmas there will be four Ordinary Meetings, in addition to the Opening Meeting, at which the following papers will be read:—November 24th—"Barry's Influence on English Art," by J. Gomyns Carr. December 1st—"The Photophone," by W. H. Preece. December 8th—"London Fogs," by Dr. A. Carpenter. December 15—"The Use of Sound for Signals," by E. Price Edwards. The following among other papers are down on the list for reading after Christmas:—"Flashing Signals for Lighthouses," by Sir William Thomson, F.R.S. "Trade Prospects," by Stephen Bourne. "The Manufacture of Aërated Waters," by T. P. Bruce Warren. "The Compound Air Engine," by Col. F. Beaumont, R.E. "Deep Sea Investigation, and the Apparatus used in it," by J. G. Buchanan. Five Courses of Lectures are announced under the Cantor bequest:—First Course—Five Lectures on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Professor A. C. Church. Second Course—Three Lectures on "Watchmaking," by Edward Rigg, M.A. Third Course—Four Lectures on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Fourth Course—Three Lectures on "The Art of Lacemaking," by Alan S. Cole. Fifth Course—Three Lectures on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter.

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THE ELECTRICIAN.

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ELECTRIC LIGHTING.

Mr. Swan's Paper, which we give in this issue, is, we believe, destined to mark a new departure in Electric Lighting. We had previously heard, from independent sources, of the success attained by his system, and have every reason to believe that in a very short time the system will in several places be open to public inspection. In order to obtain the space necessary for the Paper, we are compelled to leave over several interesting communications, and to refrain from further comments on the Paper.

ATLANTIC TELEGRAPHY.—MORE SPECULATION.

On Wednesday last the following paragraph appeared in the *Standard*:—"New York, Oct. 26.—A new American Cable Company is announced here to-day, with a capital of three millions of dollars. The cable is to be laid from New York to Flores, the westernmost of the Azores, and thence to Land's End, Cornwall. From Land's End short cables will be laid to Brest, in France, and to a place not yet definitely fixed in Holland. The cable is to be constructed by a new and improved method, and when made will possess many important advantages over any other cable now in use. By means also of specially devised instruments it is promised that one hundred words per minute will be transmitted. According to the calculations of the promoters, the cable will yield a profit of 6 per cent. on the capital invested, even at the moderate charge of 2d. per word, or 20 per cent. at 4d. per word. A portion of the capital is held in London and Paris, as well as here." Our contemporary made no comment upon this telegram, nor did it stamp the paragraph as authoritative from "our own correspondent," or through "Reuter," or any other well-known agency. We should have thought that the editor of so well-known a paper would at least have made some inquiries as to the correctness of such "news." The result of haphazard editing is to play into the hands of stock exchange gamblers, and this has been the case in the present instance.

The following is a translated *précis* from the Portuguese official *Gazette* of October 16:—

"Programme for the adjudication of the establishment of a line of Submarine Telegraph between Portugal and North America, touching in two, at least, of the Azores Islands, with a branch from one of those islands to England.

"A public competition is to be opened on November 3rd, which is to turn only on the price per word from Portugal to America within the maximum of two francs. The other principal conditions are as follows:—Deposit of £20,000 to be forfeited to the Government if the cable is not open in two years. Proposals for the modification of any of the conditions will not be accepted. The Government to receive a transit charge of $7\frac{1}{2}$ centimes per word on all telegrams passing through the Azores. The Company's charges are collected from the public by the officials of the Government at 10d. for the 'franc,' and paid by them to the Company at 9d. (Convention rate, 200 Rs. and 180 Rs.). Government telegrams to go at half rates, and their meteorological telegrams free. The Government reserves the right of suspending the correspondence by the cables. This concession will not prevent the Government from allowing cables to land in the Azores from any part of the globe whatever. If at any time the Government allows any other enterprise to lay cables to St. Michael or Flores, it shall pay to the concessionary half the cost of the sections from Lisbon to St. Michael, or of this and the section from St. Michael to Flores.

"Messages cannot be transmitted between Portugal and England until after the expiration of the concession of the Eastern Company."

We are informed that a Colonel Williams has been working for a Portuguese concession for some five years, and the above is published according to legal requirements. Three years ago Colonel Williams carried the affair to the same point, getting it published in the *Gazette* for competition, and on the day appointed the officials assembled to receive the proposals of the competitors, yet none came, not even from Colonel Williams. We suspect that Van Choate's invention, which we discussed last week, has raised hopes in the breasts of speculative Americans, and has given an impetus to the concessionaire to go to work again. Before any adjudication takes place £20,000 must be lodged at Lisbon. In the published programme the transit charges must respectively come out of the cable rates, and this, at the present price, would give the Government 12·5 per cent. on the gross receipts, even though the Company be losing money. Surely, this combined with the fact that the existing cables are far from fully worked, must open the eyes of every person to the fact that "promoters" of such a cable can have no real hope of securing a profitable investment for those who believe their words. To speak plainly, these "promoters" have but one idea, and that is to make money. Whether the money is made by ruining others is no matter to them.

It is seldom that we make use of anything marked "Pr-

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vate and Confidential," but the injurious effect such "news" has upon cable property leads us to say that for more than twelve months we have had before us a prospectus marked "The American Cable Company of New York." This prospectus states that "the system of cables will start in America from New York, and extend to the island of Flores, &c." It also states that the Company will have the "Exclusive use of new apparatus, which will double the working speed, &c."

It is impossible to read these extracts and compare them with the *Standard* telegram without suspecting the concoctors of sinister designs upon the share market.

CORRESPONDENCE.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: Now that Mr. Johnstone has sent to you a scientific argument I am delighted that we should discuss the question with, I hope, that mutual benefit which seldom fails to follow the exchange of ideas on scientific subjects.

I will first point out that all through my book I have been most careful not to say anything committing myself to the theory of one fluid or of two. I think either would explain most electrical phenomena equally well, and that there is absolutely no proof of the truth of the one or the other, or of either. They are both merely convenient conventional ideas to assist us in describing phenomena which we cannot explain.

I know, however, the danger of using these sort of conventions, as the mind is very apt, after a time, to cease to distinguish between what is known experimentally, and what is assumed provisionally as a convenient method of simplifying our language when describing any unexplained phenomenon.

I, therefore, deeply regret if, as appears from "J. L.'s" letter, I have led any student into error by what I must confess was a somewhat careless expression. I can only plead in extenuation that I believe it is the only passage in my book which commits me to either theory.

I propose, therefore, in the next edition, to alter the sentence as follows. Instead of "that the negative electricity produced on them may escape," I will write, "that the negative electrification produced in them may disappear." I think that with this correction the passage will be as accurate as our present knowledge of the science permits.

If we assume the ideas of one or two fluids to be theories, and not mere conventions, we may "prove" either by experiment as follows:—Let us attach a wire from the rubbers to the knob of a positively charged Leyden jar. Then, when we work the machine, the positive charge will be diminished. We may either say that some of the positive electricity has been drawn up the wire, or that negative has flowed down it and neutralised some of the positive. We have no means whatever of distinguishing which is the correct view.

Let us suppose a balance placed in an inaccessible room, where we cannot see it, but having a pointer fixed to an axle passing through the wall. Then, if that pointer moves, we know that a difference has been made in the weights in the two pans, but we have no means of knowing whether the difference has been caused by the taking out of weights from one pan or by the adding of weights in the other. And, further, if instead of a pointer attached to the axis, there was a cog-wheel working into a rack carrying an index, then, as that index moved up or down, we should know that the beam of the balance was moving, but if we did not know on which side of the cog wheel the rack was placed, we should not know which direction of motion of the index corresponded to a given motion of the balance; although, if we had to speak much about it, we should probably call one motion of the index the positive motion, and the other the negative.

Similarly, in electrical phenomena, no doubt all manner of beautiful and complex actions take place in conductors carrying currents, but, alas, they are like the balance in the closed room, and we can only (as yet) see the few simple motions of the index.

I have said "I do not know the direction of the flow, or even if it has a direction at all."

When two conductors of different potentials are connected by a wire, the potentials commence to equalise themselves, and as long as this equalisation is going on the wire exhibits certain properties. It is heated, but if of even resistance it is heated equally all along, we cannot say the heating begins at one end or the other. It exhibits certain electrical and magnetic properties, but we cannot say that they are produced at one end sooner than they are produced at the other,* and here I think our actual knowledge ends. When two differently electrified bodies are brought to the same state of electrification by connecting them by a wire, we say that there has been a flow of electricity along the wire, because, *assuming that electrification is produced by an excess or defect of a fluid or fluids*, then an equalisation of potentials similar to what does actually take place would be produced if a portion of this fluid had passed along the wire.

When I was a student in Professor Clerk Maxwell's laboratory I remember his trying an experiment to see if an electric current was a flow of anything having inertia. He revolved a coil of wire, carrying a current, rapidly round the axis of the coil, and then stopped the motion suddenly, and looked for an extra current, but got no effect.

Lately Professor Boltzmann has indicated a possible method of determining the direction of flow, but, as far as I remember, he got no conclusive result. I have not his paper by me at this moment, but will send you a note of it later on.

We now come to Mr. Johnstone's experiments, but I fear that, however ingenious they are, they are hardly conclusive.

Firstly, I understand Mr. Johnstone to consider that because a shock can be obtained from a Leyden jar, whose coatings are charged to two different positive potentials, there cannot be negative electricity.

This is nearly equivalent to saying that because the number 10 is the difference between 5 and 15, that it cannot be the difference between + 5 and — 5. All shocks, and other similar phenomena, depend on the sudden connecting by a conductor of bodies electrified to different potentials. A given difference of potential will produce the same effect whether the potentials themselves are high or low. For instance, the effect produced by connecting two electrified bodies whose potentials differ by 2 would be exactly the same whether the potentials were 100 and 102, + 1 and — 1, or — 100 and — 102. As an experimental illustration of this, let a battery be connected to a galvanometer, and both placed on an insulating stand and the deflection noted. The deflection depends on the difference of potential between the poles of the battery. Let now the whole system be electrified either positively or negatively to any extent, say by connecting a wire from a machine to the fluid of the battery. The deflection will remain unchanged, showing that it depends on the difference of the potentials, and not on the potentials themselves.

The earth is arbitarily chosen as the zero of potential, and bodies of lower potential than it are said to be negatively electrified.

Secondly, the experiments with the gas flame give us some interesting information as the action of charged conductors on particles of heated air or gas. Under certain circumstances, depending on the potential of the flame, there is attraction, and under others a repulsion, but I fail to see how this affects the question of the direction of the flow of electricity. How do we know that the motion of the gas particles is the same as that of the electricity? We might as well attempt to deduce the direction and speed of flow of a river from the motion of waves on its surface.

If Mr. Johnstone's view is correct we could determine the velocity of an electric current by putting an anemometer in the stream of heated air coming from the attracted or repelled gas flame.

Thirdly, "the tinfoil is unnecessary." Certainly. The only essential parts of a Leyden jar are two electrified surfaces and an insulator to separate them. It does not in the least matter whether the charges are spread over the surfaces of the glass by charging every part of it, or by sheets of tinfoil, or, as was probably the case in the experiment quoted, by films of moisture.

Fourthly, electricity will pass through glass. It passes through all substances in inverse proportion to their resistances. The resistance of glass at 200°C. is, roughly speaking, about 300,000 times that of water at 22°C. I do not quite see, however, what conclusion as to the existence or non-existence of one or two fluids can be drawn from this fact.

In my "Electricity," in my "Four Lectures on Induction," and in a lecture delivered at the London Institution (*Electrician*, Jan. 31, 1880), I have put together accounts of such facts as are actually known about the state of insulators across which electric actions are taking place. With regard to the state of conductors we have no knowledge whatever. A few years ago

* I am aware of Wheatstone's experiment with the revolving mirror and the three sparks, but I think electricians are agreed that the retardation is simply due to the gradual charging of the condenser, consisting of the wire and its insulator, as it does not give any real information about the direction of flow.

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we had no knowledge about insulators. All we can do is to hope that our knowledge may soon increase, and to be careful that, while sometimes for convenience of expression we use unproved theories of one or of two fluids as our tools and servants, we do not let them become our masters by allowing the one or the other to form our ideas or circumscribe our speculations.—

Yours, &c., J. E. H. GORDON.

Pixholme, Dorking, Oct. 24.

THE FIRE AT THE MANCHESTER TELEGRAPH OFFICE.

A serious fire broke out in this office on Sunday night last at about 20 minutes past 8 o'clock. In a room fronting York-street, the flames were first observed to issue from a lift which is used for conveying the messages handed in at the receiving office, which is on the ground floor, to the transmitting room at the top of the building. It being Sunday only about a dozen clerks were on duty. The flames in the lift soon shut off all escape by the ordinary staircase, and after the clerks had, at considerable risk, removed as much of the apparatus as they could with safety, they were obliged to make a precipitate escape by means of an iron bridge which led to the engineering department. The hoist aided the flames greatly, and every floor in the building was exposed to the ravages of the fire, which ran up the hoist and the staircase with alarming rapidity. An hour's hard work, however, gave the brigade a thorough mastery over the fire, and by 11 o'clock every source of danger had been removed. But the greatest inconvenience remained. The whole of the telegraphic communication had been severed, and for some hours Manchester was entirely isolated; the insulators of the wires had been melted with the great heat, and scores of wires were massed together like a rope. There are from 270 to 300 wires running into and through the office. Every one of these was blocked, and it required the greatest care to ascertain how the severed communication could be restored. London was amongst the first places to suffer, and a number of towns were also cut off in a moment. All the battery wires and all the line wires were destroyed. Of course the best arrangements that could be were made. As soon as the extent of the fire was ascertained by the officials at the head office it was at once seen that it would be necessary to have a large supply of new material ready to replace that which was destroyed. With great foresight, therefore, men were sent to Bolton and other places, while the fire was in progress even, to replace the material destroyed. The linemen and others were, therefore, enabled to commence work at once, and communication was restored sooner than the most sanguine could have anticipated.—*Standard*.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).

The fourteenth ordinary general meeting of the above Company was held on the 22nd inst. at the Cannon-street Hotel, the Right Hon. Viscount Monck, the chairman, presiding.

The SECRETARY (Mr. Richard Collett) read the notice convening the meeting, and the minutes of the last general meeting were read and confirmed. The directors' report, which has appeared in *The Electrician*, was taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts and the declaration of the dividend and bonus recommended, both free of income-tax, stated that the plant was in good order, the cables were working well, the receipts showed a moderate but steady increase, they had been enabled this year to give the shareholders 1 per cent. beyond the 5 per cent. they had hitherto been accustomed to, and their reserve fund was gradually growing to a considerable amount. Under these circumstances, he should not consider it necessary to do more than move the adoption of the report, but there were one or two circumstances, all of a satisfactory nature, to which he desired to draw special attention. With regard to the receipts of the cables, they showed an apparent increase of £532 over the half year ending December last; but in that half year the receipts were increased by the Cape traffic, caused by the Zulu war, to the extent of £3,700. Therefore, if they took out of the December half year's receipts that amount—which was not, they would observe, normal traffic, and which they had since entirely lost—the real increase of the past half year over the previous six months was £4,232. He had, however, often told them that it was not a fair way of instituting a comparison in any cable company that he was aware of to take two successive half years; the comparison should be with corresponding half years. Comparing, therefore, the past half year with the June half of 1879, the apparent increase in favour of the six months under review was £2,953; but in the June half of 1879 they also benefited from traffic, consequent on the Zulu war, to the extent of £5,655. Therefore, taking away that amount, which was exceptional traffic, from the receipts of the half year, the real increase in their normal traffic in favour of the past half year over the corresponding six months was £8,608. He might mention that in the past half year they had had none of the Cape traffic, which had been entirely absorbed by the South African Telegraph Company. The increase he had just mentioned of £8,608, if not a large sum, was a considerable increase, for it was considerably more than half per cent. on the whole stock; and they would see that if they went on increasing every half year in the same ratio they would not do very badly. The net percentage of profit upon capital for the last half year was £10 1s. 2d. per cent., and on the whole year, ending June, 1880, the net percentage on capital was £10 0s. 9d. per cent. Out of that they had paid the usual dividend of 5 per cent., and had added at the end of the year an additional 2s. per share, which practically raised the dividend for the whole year to 6 per cent. It was the general feeling of the Board that they should pay a portion of this 2s. bonus additional to the 5 per cent. dividend every half year as they earned it. It would not do to pay it quarterly, as they did their normal dividend [hear, hear], because until the close of the half year they could not see what they would have. The gentleman who cheered this remark could see its force. They would also see that the resolution proposed at the last half-yearly meeting, though rejected by the shareholders, was being practically carried out by the directors, who were always glad to meet any suggestions the shareholders made. As long as they made sufficient to put by what they considered a proper sum to the reserve fund they would pay the 1s. per share bonus every half year in addition to the 5 per cent. dividend. As regarded the expenses, they had amounted to £11,707 in the past half year, showing the small increase of £213 over the previous half year, and this was attributable to the legal expenses connected with the arbitration with the Western and Brazilian Telegraph Company, and in providing certain necessary requirements at the stations. The general expenses in London showed a decrease of £17. The per centage of the expenses upon the earnings were for the half year £15 0s. 1d., and for the year £14 18s. 4d. A matter frequently referred to at their meetings was the market price of their shares, and on that subject it had never before been his good fortune to congratulate them. For the first time he was happy to tell them—as all of them, however, who read the newspapers were aware—that their shares were selling for somewhat over par. They did not say it in any spirit of defiance to the shareholders, but any gentleman who thought he was in a risky concern, or was not satisfied with the dividend, now had the opportunity of selling out without incurring any loss, and with the feeling that he had had 5 per cent. for his money since he had been in the concern. He had followed his usual practice, he had tried to make everything clear to them, and to let them know as much of their affairs as the directors knew, and he concluded by moving the resolution.

The VICE-CHAIRMAN (Sir James Anderson) having seconded the motion,

Mr. SPICER said it was satisfactory to see that the traffic was growing, and that they had a property which had some life in it, but beyond that he could not join in the congratulatory observations of the chairman. The directors had given them not a dividend of 6 per cent., but one of 5 per cent., and a bonus of 1 per cent., and from what the chairman had said the latter was to be regarded as exceptional. They had, however, earned 10 per cent., and he thought the time had come to take some action if necessary to improve their position. Like the Submarine Telegraph Company they enjoyed a monopoly, owing to which they had the second best cable in the world, that of the Submarine Company alone being better. The directors, however, seemed to be determined that they should not derive much advantage from the monopoly of the Company. He referred to the dividend promised to them in the prospectus — 15 per cent., and said they had been working for six years without arriving at that figure. The chairman had said they had received 5 per cent., but allowing for the time during which they received no dividend the return had not been equal to 4 per cent. on their capital. He next alluded to the "life" of a cable, and said it was as likely for aught they knew to be 50 years as 10, or 100 years as 50; and he contended that with the reserve fund they had already accumulated—£303,000—it would be quite sufficient to put by £20,000 a year. The Submarine Company, who paid a dividend of 19 per cent., put by only 5 per cent. on their gross receipts, and had found that that had answered satisfactorily. It was to be remembered that this Company's monopoly was expiring—it had now only 12 years to run—and unless the shareholders made a change the directors would use the reserve fund in laying another cable and increase the capital to £2,000,000. They would inevitably have competition when their monopoly ceased. He should move a resolution after the disposal of the report limiting the future transfers to the reserve fund to £20,000 per annum.

Mr. URWICK intimated that he should second the resolution of Mr. Spicer, whose remarks he endorsed.

Mr. HOUSTON held that £20,000 would be wholly inadequate to put to the reserve fund. He could not agree that the dividend of 6 per cent. was "miserable," even to those who had bought their shares at par. He thought they should pass £50,000 a year to the reserve fund and receive 7 per cent. dividend.

Mr. NEWMAN acquiesced in the remarks of the previous speaker. He warmly supported the policy of accumulating a strong reserve fund, pointing out that it would be most advantageous in the event of competition on the expiration of their monopoly.

Mr. GRIFFITH thought a good deal could be said in favour of both sides. The first speaker had estimated the "life" of a cable at fifty years, but so far as experience went that would not be the case. For instance, many of the cables of the Atlantic Company had perished much earlier—about ten years. There were various circumstances which would act on the duration of a cable. It should be remembered that the three sections of their cable were of the same age, and were wearing out at the same rate. All contingencies could best be met by a strong treasury, and the very fact that the monopoly must cease so soon was an argument in favour of its being kept up. Their business was steadily increasing, and they might hope for increased dividends, but he thought they could afford to wait two or three years longer, till the reserve fund amounted to sufficient to lay a new cable.

Mr. BARTON said he had never attended any of their meetings with greater pleasure than that one. He also thought the fact of the monopoly passing away was a reason why the reserve fund should be properly maintained. He assumed that a new cable could not be laid without the consent of the shareholders, and that the disposal of the reserve fund was also in the hands of the shareholders.

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Mr. NEWTON pointed out, in reply to the first speaker, that the reserve fund could be used, if necessary, in the renewal of their cables without increasing the capital. The reserve fund of the Submarine Company was so small because its sections of cable were so short. The sections of this Company's cables were much longer, and a larger reserve fund was necessary. He, however, thought that £50,000 a year would be sufficient, and suggested that instead of giving a bonus it should all be called dividend.

Mr. MARSHALL also said that he had never attended a meeting with greater pleasure. He agreed with the last speaker in recommending that they should pay 6 per cent. dividend, and that the increase should be paid quarterly. As to Mr. Spicer's remarks, it should be remembered that the fact of the reserve fund being so large of itself enhanced the value of their shares.

The CHAIRMAN, in replying, said he had frequently addressed them on the subject which had been brought before them. The shareholders would not receive a large dividend with greater satisfaction than it would afford the directors to pay it. If they required to renew their cable the advantage of the ready money of the reserve fund would be inestimable. That had ever been the guiding principle of the board. Contrary to what had been said, they had not sufficient reserve fund to renew the longest section of the cable, and as had been said very acutely by Mr. Griffith, all their cables were laid at the same time. It was, therefore, possible that they might all break together, and if they had to raise half the capital that would be required what interest did they think they would have to pay, seeing that the only security they could offer would be the monopoly they had for the next twelve years from now? After the observations which had been made in the course of the discussion, he did not think it necessary to reply further on this point. As to the distinction which had been made between "dividend" and "bonus," if they received the money he failed to see the difference between the one and the other. With regard to laying down another cable, they would not do so an hour before it was necessary; and he told them frankly that they could carry a much larger traffic than at present with the existing cables. Mr. Spicer had drawn a melancholy picture, but he would remind that gentleman that the direct effect of the reserve fund was to enable them to renew their property without increasing their capital. As to fifty years being the life of a cable, two of the Atlantic Company's cables were now useless at the bottom of the ocean after ten years' working. They had no wish to deprive the shareholders of a shilling of dividend which they could safely and honourably pay them. He then put the resolution, which was carried unanimously.

On the motion of the CHAIRMAN, seconded by Mr. F. YOULE, Mr. M. H. Chaytor was re-elected to his seat at the Board, as was also Mr. W. H. Clark, on the motion of the CHAIRMAN, seconded by Mr. H. D. GOOCH.

Mr. MARSHALL next moved and Mr. ROUX seconded the re-election of the retiring auditors, Messrs. H. Dever and J. Gane.

Mr. SPICER then moved his resolution substituting £30,000 for £20,000.

Mr. W. FORD pointed out that, according to the articles of association, the fixing of the amount to be placed to the reserve fund was vested in the Board, and an extraordinary meeting would be required to deprive them of this power.

The CHAIRMAN stated that this was so.

Mr. SPICER observed that in that case he had nothing further to say, except that it was probable that some action might be taken on what he had put forth.

Mr. URWICK suggested the resolution to the Board as a recommendation.

On the motion of Mr. MARSHALL, seconded by Mr. HOUSTON, a cordial vote of thanks was passed to the chairman and directors.

The CHAIRMAN having expressed the acknowledgments of his colleagues and himself, the proceedings terminated.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).

The seventh ordinary general meeting of the above Company was held on the 27th inst., at the City Terminus Hotel, under the presidency of Mr. C. W. Earle.

The SECRETARY (Mr. Constantine M. Cooper) read the notice convening the meeting, and subsequently the minutes of the last general meeting.

The report of the directors for the six months ending June 30th last stated that the amount to credit of revenue was £36,358, and the expenses had been £21,534, leaving a balance of £14,824, which, with the balance of £1,017 brought from last half year's account, made a total of £15,841. Of this sum the directors had placed £10,000 to reserve account, leaving £5,841 to be carried to the current half year's account. They considered that it was incumbent upon them to negotiate for a revision of the Colonial Acts under which the telegraph was established, with the view of obtaining an increase in the amount of the subsidies and a modification of the onerous conditions under which they are payable.

The CHAIRMAN, in moving the adoption of the report and accounts, said: Although it was very disheartening and discouraging that they should again have to present a balance sheet with the preference dividends in suspense, he did not suppose that there was any one who was very much disappointed about it. The general tenour of all their reports of late must have prepared them for their present position more or less. The cables had now been down for ten years, and ten years in those seas seemed to be about the "life" of a cable—they began to be "shaky" in that time; and with revenue such as they had been in possession of, it had been impossible for them to renew these cables at the time, as they would have done had they been in more flourishing circumstances. He had often told them that the revenue of the Company when in the best working condition possible, with all the subsidies paid, and all the lines in working order, was only half the average of other trans-oceanic companies per mile—that was to say, that when they went into the question they found that, while the others received £40 per mile per annum gross, this Company was receiving £19. The difference between those two figures explained the position of this unfortunate Company. The present board had nothing to do with the origin of the Company, but it was never supposed that the Company could earn enough to support itself, and the difference was to be made up by subsidies. The traffic estimates were very much exaggerated, and the result was that they found they got a very small traffic, and the subsidies were not sufficient to bring up the undertaking to a prosperous condition. Not only had they these radical defects, but they had also the hard conditions which were imposed on them by the various colonies. For instance, with regard to the Spanish colony, it was one of the conditions that they should carry their Government messages for nothing. If those messages were paid for it would give them another £4,000 a year. Theirs was also the only Company which had to supply free news and market prices to those places that gave them subsidies. That was a very great disadvantage. As to the expenditure, he believed they would compare most favourably with any similar concern. They had lately reduced the victualling scale on their ships, and he was not prepared to say they must not go a little further in this direction. He thought they did their work as cheaply as they possibly could, consistently with decent efficiency, when the lines were open. It might seem to some of the shareholders that, having made a profit upon the half year, and having something at their reserve fund, they ought to pay a dividend on account of the preference shares; but the fact was that since the turn of the half year they had had a good many accidents to their cables. The subsidies had fallen off, the traffic, being in an interrupted state, had fallen off, and therefore if would not only be unwise, but practically impossible for them to pay anything on account of the preference dividends. They had had to equip this second ship, as the only means they knew of to restore the property and put it in a dividend-paying condition again, and the expenses of that ship and the cable she carried out had absorbed the remainder of their investments, and they had had to borrow from their bankers to go on with the business. Although their position was to be regretted, and none of them regretted it more than he, it was a position which was forced on them by the accidents to which they were exposed. He then moved the resolution.

Sir JAMES ANDERSON having seconded the motion,

Colonel TILNEY said that he represented a great many people, but in his own individual capacity he held more shares than all the Board. He did not think there was that heartiness in the management which there ought to be. The report was disappointing, but he did not feel disheartened, for they had a concern which, with from seven to ten breaks, had earned an income in the last half year of £36,000. That was a fact which showed that the telegraph system was a necessity—Governments and peoples could not do without it; and, therefore, he was hopeful with regard to the future. He strongly dissented from the chairman that the cable was worn out, and it was opposed to what he had mentioned to him (the speaker) on a previous occasion. He felt that in the future, from the actual growth of the telegraph system, however the concern was managed, whether ill or otherwise, the receipts would increase, and that within a reasonable time there would actually be a dividend for the ordinary shares. He referred to the salaries and other expenses, which he regarded as too large.

The CHAIRMAN stated that the cost of the "Duchess of Marlborough" was £11,000, fitted up complete, and her tonnage 402 gross.

Mr. VEARES dissented from the remarks of Colonel Tilney.

The CHAIRMAN, in reply, said the hire of the sloops was entirely dependent on the number of interruptions to the cable, but the use of a sloop enabled them to charge the telegraph rate over that section, and the expense was pretty well recouped. He repeated that the general expenses compared favourably with those of other similar companies. They had twenty-three stations, and employed one hundred clerks. They must have two men at each station. Colonel Tilney thought he had not been correct in his estimate of the life of the cable. Their cables had been down ten years. One of them had broken ten times, and three times this year. At the beginning of January they had seven sections interrupted, and at the present moment they had nine broken sections, seven of which interfered with the traffic. The ground on which the cables lay was particularly bad in the West Indies, owing to which it appeared difficult to get a long life out of a cable. There had been some unavoidable delay in the repairing of the Trinidad cable, into which thirty miles of new cable had to be put, but the repair had been completed some time since. They would get rid of one of the ships as soon as possible. Her purchase was rendered necessary, as it was a very special kind of ship which was required for the work. There was only one ship available for hire, the charge for which was from £80 to £100 a day. They once had the head-quarters at Jamaica, but it did not answer, and it was far more convenient to have them at St. Thomas. The present Board had taken office at the instance of a committee of shareholders, and it was really part of the bargain that they should receive their fees. Before the present Board took office no dividend was ever declared, whereas they had paid £105,000 in dividend.

After a few observations from Mr. HENRY HOLMES to show that the ship "The Duchess of Marlborough" was a cheap vessel and a judicious purchase,

Mr. ROBINSON KENDAL addressed the meeting.

Colonel TILNEY then moved an amendment increasing the number of the directors to eight by the election of Mr. R. Kendal, and spoke of the necessity for "fresh blood" on the Board.

The SOLICITOR (Mr. Burt) said it was out of order, as no notice had been given.

Colonel TILNEY persisted that it was in order, but ultimately moved the adjournment of the meeting, with the object of bringing forward Mr. Kendal as a director.

The SOLICITOR pointed out that it could not be done at an adjourned meeting.

Mr. GRIFFITH, Mr. WILLIAM ABBOTT, and other shareholders having addressed the meeting,

The CHAIRMAN put the resolution for the adoption of the report, which was lost, the numbers being 15 for and 20 against. A poll was demanded, with which Colonel Tilney and his supporters would have nothing to do. The poll was taken, and at the close the chairman announced the result, there being thirteen shareholders present, representing 2,102 shares and 380 votes, and 341 proxies, representing 24,929 shares and 7,058 votes, making 27,037 shares and 7,438 votes in favour of the resolution, and no votes against. He, therefore, declared the resolution carried.

On the motion of Mr. VEARES, seconded by Mr. QUILTER, a vote of thanks was passed to the chairman and directors, and the meeting separated.

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ABSTRACTS OF SPECIFICATIONS.

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[*We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts*—ED. *E.*]

1046. COMPRESSING AIR BY ELECTRICITY FOR OBTAINING MOTIVE POWER, *V. Poulet and E. Commelin.—Dated 10th March*, 1880.—*(Not proceeded with)*. 2*d*.

An electro-magnet attracts a rod, which serves as a piston, a lever being connected with the piston to increase the power. A connecting rod is connected to a fly-wheel and an air pump in connection with a pipe, through which air is compressed into the boiler. An inlet pipe for air is fixed on the boiler, and communicates with the slide and slide rod of a secondary piston.

1112. GALVANISING OR COATING METALS, &c. *J. E. Reynolds, M.D. — Dated 15th March*, 1880. 4*d*.

This consists in increasing the surface to be coated in or covering it with a hot or cold solution containing dissolved lead (either in the form of a salt of the metal, or of oxide or hydrate dissolved by aqueous soda, potash, or lime (with or without the addition of other metallic salts or hydrates of ammonia), and a body capable of affording sulphur by gradual decomposition in the liquid, but preferably the body known as thio-carbamide or sulpho-urea.

1125. ELECTRIC RAILWAY SIGNALS, &c., *J. C. Mewburn.—Dated 16th March*, 1880.—(*A communication*). 8*d*.

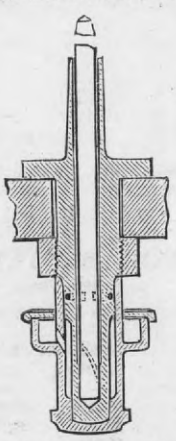
This consists generally in a system and appliances whereby a moving locomotive or train of cars at different times forms automatically a part of several electric currents, by closing the same to operate an alarm placed on such locomotive or train, or operate any desired signal on the line of the railway, or lock a closed switch or draw.

1136. MAGNETO-ELECTRIC AND DYNAMO-ELECTRIC MACHINES. *J. H. Johnson.—Dated 16th March*, 1880.—(*A communication*).—*(Not proceeded with)*. 4*d*.

This consists in enabling these machines to furnish an alternate current without the employment of an exciting machine for producing a continuous current for magnetising the inductors.

1151. MICRO-TELEPHONIC APPARATUS, *R. H. Courtnay.—Dated 17th March*, 1880.—(*Not proceeded with.*) 2*d*.

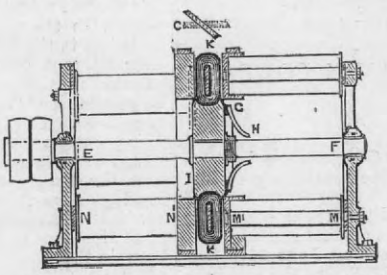
An iron or steel bobbin, with a soft iron base, is, with a resisting medium, coiled with a number of lengths of wire insulated and connected by one end to the bobbin. The bobbin is connected with a pendulum or springs of any suitable metals. This apparatus is mounted in a case connected



with ball and switch, either with or without a glass or other chamber. Carbonate or other suitable salts of metal, and the metals in a finely divided state, and also an alloy of metals of variable electrical resistance are so treated as to be easily mixed with water and moulded to any required form for telephonic transmitting in place of carbon.

1178. DYNAMO OR MAGNETO-ELECTRIC MACHINE, *J. Perry.—Dated 18th March*, 1880. 6*d*.

Dynamo machines are applications of a principle discovered by Faraday. In the Gramme and Siemens machines the magnetic field is weak because the inducing magnets are at a considerable distance apart. The use of soft iron partially obviates this fault, but with high speeds the soft iron can no longer help in intensifying the magnetic field in which the conductors move, and even at low speeds the rapid changes of polarity cause great heating effects. The object of the inventor is to get a very intense magnetic field, and at the same time have continuous currents. The movable conductors consist of coils of insulated copper or iron wire usually placed round a strong annular core of steel, phosphor bronze, or soft iron. In the machines of Gramme, Siemens, and others, each winding of wire is as nearly as possible in the plane containing the axis of rotation. In the machines of Wilde and others each winding of wire is as nearly as possible at right angles to the axis of rotation, or its plane is parallel to the direction of motion. Each winding of wire on the rotating part of this machine makes a decided angle with the axis of rotation, say from twenty to seventy degrees. In winding the ring the inventor usually divides the core into two halves; a great number of thin wedge-shaped coils are wound upon a bobbin; they are soaked in some stiffening insulating material, and when this hardens they are removed from the bobbin, retaining the proper wedge shape; they are then slipped upon the halves of the annular core, which, when nearly filled with them, are screwed together at the two ends, a little of the ring having to be wound by hand. In the figure E F is a shaft made to rotate; A B is a ring of phosphor bronze on which a great number of thin wedge-shaped coils are packed so as to form an anular armature, whose section is shown at K K. The plane of each winding of this armature makes an angle of 50° with the direction of motion when turning with the shaft. Three of the coils are shown at C. The armature is firmly fixed to the shaft and is kept from changing its shape during rotation by the wooden discs I I., and the outer rings of wood and metal. All the coils form one closed circuit, but the ends of one thin coil and of its neighbour are also fastened to an insulated rod of copper G H, there being as many rods as there are thin coils, and one end of each is fixed to a vulcanite ring on the



discs I, the other end being free. From these rods currents are taken away by four contact pieces which rub or roll on them; M M are four electro-magnets bolted at M M to a ring of iron and to the frame, while their ends M^1 M^1 are fixed to a frame of wood; N N are four similar magnets fixed in the same way on the other side of the armature, but do not come opposite the magnets M M, but in the position shown in the small figure. The claims of the inventor are (1) the use of coils on a movable armature, such that the plane of each winding makes an angle, not a right angle, and not zero, with the direction of motion. (2) The method of placing magnetic poles of opposite polarity near each other on opposite sides of an armature of coiled wire, so that nearly all the lines of force make a decided angle of from 20 to 70 degrees with the direction of motion, or so that a straight line drawn from the centre of one pole piece to the centre of the other, makes an angle of from 20 to 70 degrees with the direction of motion of the armature at that place. (3) The use of an annular or prismatic armature consisting of coils wound at right angles to, or making any other angle with the direction of motion when soft iron is not used as the core, that is, when the coils are fixed on any other core than one of soft iron, or when they have no coil. (4) The methods of manufacturing an annular armature of coils with or without a core.

1184. TELEGRAPH WIRES, *J. T. King.—Dated 19th March*, 1880.—*(A communication.)* 6*d*.

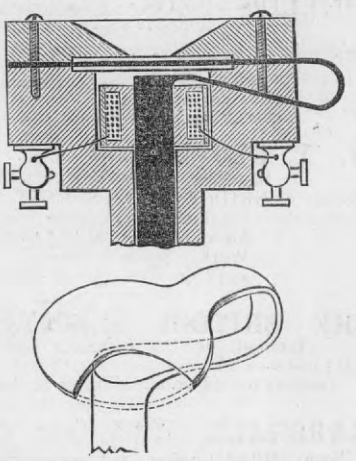
To insulate telegraph wires they are surrounded with powdered charcoal, the wires being laid in boxes or containers, and covered with charcoal, or the charcoal made to adhere to the surface of the box, or container, or wire, which have been first coated with coal tar or other adhesive substance. A cable of wires may have the interstices filled with paraffin, and the charcoal applied as an outer coating. The box or container is formed with grooves to receive the wires, such grooves enamelled, and the surface of the box in contact being with the earth is japanned or tinned. A cover fits over the box, and channels are formed on it and the box to receive cement and form a tight joint.

2114. PERFORATING PAPER FOR TELEGRAPHIC PURPOSES, *W. R. Lake.—Dated 24th May*, 1880.—(*A communication.*)—(*Complete*). 1*s*.

This consists specially in the mechanism for operating the punches and selecting the number necessary to form the perforations, corresponding to each character to be produced at the receiving instrument for alternating or reversing the position of the perforations when letters of an uneven number of parts succeed each other, in order to prevent two positive or two negative impulses from following each other, which would prevent the proper alternation in the current necessary to produce the characters at the receiving instrument, and to provide for automatically feeding the paper in proper varying lengths.

2419. TELEPHONE RECEIVERS, *R. M. Lockwood and S. H. Bartlett.—Dated 15th June*, 1880. —(*Complete.*) 6*d*.

The diaphragm is formed upon a reduced arm forming part of an extension of one pole of a single bar magnet, which so supports the diaphragm as to make it constitute a sounding board, to which the disturbances in the current are conveyed by molecular action or by difference in



degree of polarity in different parts of the pole, to which it is connected, rather than by mechanical vibration of the diaphragm due to its attraction to and repulsion by the magnet, as in the usual construction. The perspective view shows the diaphragm at the end of the magnet.

2465. NICKEL PLATING, *J. Wetter.—Dated 18th June*, 1880.—(*A communication.*)—(*Complete.*) 6*d*.

This consists, first, of a metallic electro-depositing solution to which benzoic acid has been added; secondly, of a metallic electro-depositing solution to which salicene or other salicylic acid has been added; thirdly, of a metallic electro-depositing solution to which gallic or pyrogallic acid has been added; fourthly, the combination of phosphate of nickel with sulphate of nickel in such solution; fifthly, the combination of citrate with the sulphate or chloride of nickel in such solution; sixthly, an electro-depositing solution of the single or double salts of nickel to which benzoic acid has been added; seventhly, an electro-depositing nickel-solution to which pyrophosphate of soda has been added either with or without the bisulphite of sodo.

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	—	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	Victoria Docks.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Canea.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

ADDRESSES.

*** NOTICE.—It has been decided to devote a portion of the advertising space of *The Electrician* to giving the addresses and specialities of the principal firms of Electricians, Engineers, &c. A moderate charge per annum will be made for the insertion of such addresses weekly, and firms desirous to be included in the list are requested to apply to the Manager, 396, Strand. The addresses must not occupy more than five lines.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

W. T. GLOVER and Co., Insulated Wire Manu- facturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manu- facturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the Best Telephone Transmitter (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Oct. 27.	Business Done Week Ending Oct. 27. Highest.	Lowest.
Anglo-American Ordinary	62½, 63	63¾	63⅜
Do. "B"	93½, 94	95	94⅜
Do. "A"	32⅛, ¾	33⅞	32¾
Brazilian	10 3-16, 5-16	10⅜	10
Cuba	9, ½	9⅜	9⅛
Do. Ten per Cent. Pref.	16¼, ⅜	16⅓	16⅓
Direct Spanish	2½, 3	2⅝	2⅝
Do. Ten per Cent. Preference	12, 12⅓	12⅓	12
Direct United States	12, ¼	12¾	12⅛
Eastern	9⅜, ⅞	10	9 13-16
Do. Six per Cent. Debenture	103, 106	105	104
Do. Five per Ct. do. 1899	103, 105	106	105
Do. Six p Ct. Pref	12½, ⅝	12¾	12⅓
Eastern Extension	10 1-16, 3-16	10¼	10
Do. Six per Ct. Deb	108, 111	—	—
German Union	9⅜, 10¼	9⅞	9¾
Globe Telegraph & Trust	6 13-16, 15-16	7 1-16	6⅞
Do. Six p Ct. Preference	12 1-16, 3-16	12⅛	12
Great Northern	9⅛, 10⅛	10⅛	10
Indo-European	24⅛, 25⅛	—	—
Mediterranean Extension	2¾, 3	3 1-16	3
Do. Eight p Cent. Pref	10⅜, 11	10⅞	10⅞
Reuter's	11, ⅓	—	—
Submarine	245, 250	—	—
West India and Panama	1½, ½	1 7-16	1 5-16
Do. Six per Cent. 1st Preference	6⅝, ⅞	6¾	6⅝
Western and Brazilian	8, ¼	8¼	8
West. Union 7 p. Ct. 1st Mt.	120, 125	—	—
Do. Six per Ct. Sterg.	103, 105	104½	103¾

TRAFFIC RECEIPTS FOR SEPTEMBER, 1880.

Companies.	Sept., 1880.	Sept., 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	1,800 estd.	3,314	—	1,514
Direct Spanish Telegraph Company	1,538	1,121	417	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	43,717	39,369	4,348	—
Eastern Extension Telegraph Company	28,771	26,980	1,791	—
Great Northern Telegraph Company	22,320	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

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PATENT VULCANISED FIBRE.

A NEW SUBSTITUTE FOR LEATHER, RUBBER, GUTTA PERCHA, &c.

It is made of two qualities, Flexible and Hard, each having its specific uses.

The Hard is a substitute for Metals, Ivory, Vulcanite, Ebony, &c., and is extensively used for Pneumatic Carriers, Electric Machines, Batteries, &c., it being a good non-conductor.

Both qualities of the Vulcanised Fibre are uninjured by the action of Hot or Cold Water, Oils, Spirits, Grease, Acids, Ammonia, and many of the chemical agents which utterly destroy Leather, Rubber, and Metals.

Sold in Sheets of 5ft. 6in. by 3ft. 6in., from one fiftieth to an inch in thickness.

THE VULCANISED FIBRE COMPANY,

SOLE AGENTS—MOSSES & MITCHELL, 62, QUEEN VICTORIA STREET, E.C.

Now ready, post quarto, cloth gilt, 272 pages, price Sixteen Shillings,

LIGHTNING CONDUCTORS:

Their History, Nature, and Mode of Application.

By RICHARD ANDERSON, F.C.S., F.G.S., Member of the Society of Telegraph Engineers; Assoc.Inst.C.E.

WITH NUMEROUS ILLUSTRATIONS.

LONDON: E. and F. N. SPON, 46, Charing Cross. NEW YORK: 446, Broome Street. 1880.

"The work is written in a clear and agreeable style, and no pains have been spared in consulting authorities and collecting statistics."—*Saturday Review.*

"Mr. ANDERSON's book is not only good, but is the best of its kind, and deserving the careful attention not only of every student, but every householder."—*The Electrician.*

TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY (Limited).—SECOND BONUS TRUST.—Notice is hereby given, that the ELEVENTH DISTRIBUTION on the Certificates, issued under the Trust Deed of the 12th March, 1875, will be made on and after the 1st November, 1880. The distribution, which arises from dividends on the shares held by the Trustees, will be at the rate of 3s. per £5 Certificate, and the amount will be paid two clear days after presentation of Coupon No. 11 at Messrs. Barclay, Bevan, and Co.'s Bank, No. 54, Lombard-street.

Notice is also given, that supplementary sheets containing six coupons (numbered from 7 to 12, both inclusive), may be obtained by such holders as have not already procured them upon production of the respective Certificates, at 38, Old Broad-street, London, E.C.

By order of the Trustees,

D. KINGSFORD, Secretary to the Trust.

No. 38, Old Broad-street, E.C., 26th October, 1880.

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.

Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

Letters of Credit and Circular Notes issued.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

The Birkbeck Building Society's Annual Receipts exceed Four Millions.

HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

A Pamphlet, with full particulars, on application.

FRANCIS RAVENSCROFT, Manager.

Southampton-buildings, Chancery-lane

THE "JAMIN" PATENT ELECTRIC LIGHT

COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.

Capital 8,000,000 francs.

Proprietors of the Gramme Patent Machine for alternate currents.

J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

Crown 8vo., 94 Illustrations, 7s. 6d. cloth (postage 5d.).

ELECTRIC LIGHT: its Production and Use. By J. W. URQUHART, C.E. Edited by F. C. WEBB, M.I.C.E., M.S.T.E., &c.

"An interesting volume."—Mining Journal.

"A clear and practical little book."—Westminster Review.

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EQUITY and LAW LIFE ASSURANCE SOCIETY,

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CAPITAL, £1,000,000, FULLY SUBSCRIBED.

The most stringent tables have been used in valuing the Society's liabilities. Lapsed Policies are revived within the period of three months upon payment of the overdue premium and a small fine, without evidence of health. Whole-World Licences will be granted in most cases without payment of extra premium. Nine-tenths of the profits are divided among the assured every five years. At an extraordinary general meeting held on June 9, 1875, the sum of £844,379 was set aside as the value of the Society's liabilities under its Assurance and Annuity Contracts, and £173,180 was ordered to be divided as bonus; leaving a balance of undivided profit of £20,033. Nine-tenths of the sum divided was allotted among holders of policies for £2,500,000.

TABLE OF THE TOTAL ADDITIONS MADE UP TO DECEMBER 31, 1874, TO POLICIES OF £1,000 EACH.

Ages at Entry.	NUMBER OF PREMIUMS PAID.					
	Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	—	—	787 10 0	517 0 0	310 10 0	137 10 0

G. W. BERRIDGE, *Actuary and Secretary.*

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

3, BEDFORD COURT, COVENT GARDEN, W.C.,

Will on and after the 1st May, 1880, REMOVE to

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C.

The Gower-Bell Loud Speaking Telephone.

TELEPHONE LINES ERECTED and MAINTAINED.

EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.

Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

TO AMATEURS.—JOHNSTON and COMPANY'S NEW PRICE LIST contains everything necessary for EXPERIMENTS with Electricity, Electrotyping, Plating, &c., and will be sent post free on application.—121, Wardour-street, London, W.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby.

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SLIP

TURKEY.—Messages in code or cypher can no longer be received for Turkey and Bulgaria.

CANADA.—Heavy thunderstorms have caused interruption in some of the Western Circuits in Canada.

THE SOCIETY OF TELEGRAPH ENGINEERS.—The hour fixed for the first meeting of this society on the 10th inst., at Broad Sanctuary, is 9 p.m.

THE PHOTOPHONE.—The "Recent Science" section of this month's *Nineteenth Century* opens with a clear and succinct account of Professor Bell's latest discoveries.

SOUTH AMERICA.—Telegrams for Peru, Chili, Bolivia, Uruguay, and the Argentine Republic are delayed in consequence of the cable between Monte Video and Rio Grande do Sul being interrupted.

SOUTH AFRICA.—The public are warned that, the land wires in the neighbourhood of Natal being broken, the delivery of messages addressed to Cape Colony and Orange Free State is very uncertain.

THE LATE GLASGOW EXHIBITION.—We hope to be able to give the jurors' report in connection with the electric light exhibits as soon as it is ready, but as yet the testing of the apparatus is not complete.

MR. HERRING AND THE POSTAL TELEGRAPH DEPARTMENT.—Mr. Herring is still persevering to obtain the promised carrrying out of the agreement between the postal department and himself, but as yet ineffectually.

INTERESTING TO CITY CLERKS.—It is rumoured that the countermen at telegraph offices throughout the City are again to be displaced to make room for girls. This is great news for merchants' clerks, office boys, and gay loafers generally, but not for their masters.

BOW STREET.—The whole of the Rooms of a "kiosk" which has just been opened in Bow-street are lighted by electric lamps on Messrs. Siemens' system, the engine below, in addition to assisting in the manufacture of aerated waters, driving six lights of 300 candle-power each.

THE DIRECT UNITED STATES CABLE COMPANY (LIMITED).—The note relating to the dividend of this company in our last issue should read:—"The Board has resolved upon the payment of an interim dividend of 5s. per share (not 2s.), being at the rate of 5 per cent. per annum," &c.

THE GOVERNMENT AND THE TELEPHONES.—The trial between these litigants will probably be heard on Nov. 22. We have from time to time expressed our opinion that, whatever is the result of the trial, the Government having the "telegraphs" ought to have the control of telephonic communication.

THE PARIS INTERNATIONAL CONGRESS OF ELECTRICIANS.—We are glad to learn from *La Nature* that the Exhibition in connection with this Congress will extend from the 1st August to the 15th November. It will be held in the Palais des Champs-Elysées. The date of the Congress itself is September 15th, 1881.

CONSOLATION FOR THE GAS COMPANIES.—Messrs. Crossley Brothers have constructed no fewer than 1,250 gas engines—probably even many more, as that number is said to be actually in use in England alone. The gas companies themselves are employing them. This is the beginning of a wiser policy it may be hoped.

MR. EDISON AND MR. SWAN.—The publication of Mr. Swan's lecture has revived the dispute about the burnt cardboard. The general impression here is that Mr. Swan errs on the side of generosity and excess of modesty; and it is now more than hinted that Mr. Edison has got some of his inspiration from Newcastle.

THE GOWER-BELL TELEPHONE.—Public interest in telephones appears to be gaining ground. The Gower-Bell Company, whose instruments have been adopted by the Government Departments, are said to have received in the two months since their registration applications relating to more than £40,000 worth of telephone outfits.

MUNICIPAL FORESIGHT.—The Barnsley Corporation have rejected the proposal to purchase the town gasworks, on the ground that there is "the probability that lighting by gas will shortly be superseded by other means of lighting." What other? As oil can hardly be meant, there is an excess of caution about this prediction reminding us of "another" place.

THE CUBA SUBMARINE TELEGRAPH COMPANY.—The number of messages passing over the lines of this company during the month of October was 2,022, estimated to produce £2,100, against 3,084 messages, producing £3,512 in the corresponding month of last year. The traffic receipts for the month of August, estimated at £2,000, realised £1,886.

LONDON INSTITUTION.—Among the numerous lectures to be given in this institution during the winter session, we notice two devoted to electrical subjects—viz., on December 16, at seven, Dr. Oliver J. Lodge discusses "The Relation between Electricity and Light," and on January 20th, 1881, at seven, Professor W. E. Ayrton is to discourse on "The Production of Electricity."

GOVERNMENT PRIORITY.—The Government of Burmah, of course, claims priority on the telegraph lines. This is how it works. State affairs in that notorious but otherwise insignificant empire are of such urgency and magnitude that if you despatch a letter and a telegram from Thayetmyo to the capital on the same day, they usually reach their destination a week apart—the letter first.

THE TELEPHONE AND THE HAMBURG MERCHANTS.—It is reported that the Post Office authorities in Hamburg contemplate establishing a net work of telephonic lines similar to that recently instituted in Berlin. The system of suburban residences prevails very largely in the neighbourhood of Hamburg, and communication between them and places of business will be a great boon to the merchants.

THE "PHILOSOPHICAL MAGAZINE."—The current number of this magazine contains papers "On the New Action of Magnetism on a Permanent Electric Current," by E. H. Hall; "On Magneto-Electric Induction," by Frederick Guthrie and C. V. Boys; "On the Thermic and Optic Behaviour of Gases under the Influence of the Electric Discharge," by E. Wiedemann; also several notes on electrical subjects.

TELEGRAPH STORES.—The Telegraph Department of Berne (Switzerland) is seeking tenders for, among other stores, 4,400 creosoted poles, five tons galvanised wire (4mm. diameter), 12,000 insulators, 3,000 side brackets, 30 ebonite receivers, 2,000 zinc plates, 1,500 zinc cylinders, two tons sulphate of copper. Particulars can be had from Den Telegraphendirektion, Berne, and tenders will be received till the 20th inst.

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Last Week's Storms and the Telegraph.—In consequence of the severe storms on the Wednesday and Thursday of last week several of the provincial papers had their supply of London news greatly curtailed. One at least of the Glasgow special wires was interrupted during the whole night. No serious damage, however, appears to have been inflicted, as was to be feared, by the unprecedented floods over large tracks of the country.

Interruption of Telegraphic Communication.—Telegraphic communication with Sheerness has been interrupted by an accident which happened recently on the Sheerness and Sittingbourne Railway. The flap of a goods truck came unfastened and struck the telegraph posts, knocking five of them down. The special Admiralty wires to Sheerness were damaged, and a portion of the cable running under the River Swale was torn up and broken.

Mr. Edison and the "Lancet."—With reference to the paragraph which we quote from the *Lancet* about Mr. Edison's hodge-podge of anæsthetics, the *English Mechanic* explains that it took its information verbatim from Mr. Edison's patent, purchasable at the Patent Office for a few pence. Such reckless expenditure in the interests of science is very noteworthy—unfortunately the *Lancet* does not value the discovery at any pence, many or few.

Work at Night.—We understand that the work on the North London Suburban Tramways is being carried on during the night by the use of the electric light. Messrs. Wilkes and Company are the contractors for the work, and the electric light is supplied by Mr. E. Paterson, 76, Little Britain. We imagine that the greater portion of London street work would be more safely and economically done at night, for which the electric light gives all that is required in the shape of illumination.

Death by Electric Shock.—It was not for nothing, it seems, that the poor fellow was killed on board the "Livadia." A quasi scientific contemporary remarks that the occurrence "proves very conclusively the enormous power of the current." To our thinking it proves conclusively the incredible carelessness of the persons responsible for the appliances. Whoever they may be they certainly must have known the power of the current sufficiently well to have rendered proof unnecessary, and therefore impossible. We hope and trust that the proof is now conclusive in the sense of being final.

Overhead Wires in London.—A Fellow of the Royal Society writes to a contemporary calling attention to the increasing danger from telegraph wires being erected over streetways. We recently described the perilous condition of some City thoroughfares; and we now learn that several wires extend from one end of Burlington-gardens to the other. The writer suggests that the wires should be linked together at intervals by some non-conducting material to afford mutual support in the case of breakage of one. We fear that the increased leverage thus given would add to the risk of a downfall of many.

Chills.—Probably the worst blunder ever made by the telegraphists was one that occurred in the case of a St. Louis merchant, who, while in New York, received a telegram informing him that his wife was ill. He sent a message to his family doctor, asking the nature of the sickness, and if there was any danger, and received promptly the answer, "No danger. Your wife has had a child. If we can keep her from having another to-night, she will do well." The mystification of the agitated husband was not removed until a second inquiry revealed the fact that his indisposed lady had had a "chill."

The Press on Mr. Swan's New Lamp.—The singular equanimity with which, so far, the news of Mr. Swan's important discovery has been received in London is, says the *Examiner*, "a striking illustration of the incredulity which grows out of false report." Compared with our own countryman's revelations the "sensational announcements from Mr. Edison's laboratory sink almost into insignificance." "There is," the *Examiner* thinks, "no cause for panic, but great reason for caution. The gas companies have now learnt the worst that can probably befall them, and learning it in good time there will, it is to be hoped, be no room for fraudulent speculation."

Carbon.—Experiments recently made by MM. Naccari and Pagliani, and separately by Dr. Werner Siemens, prove that great pressure applied to carbon makes very little difference to its resistance; and it is hence concluded that the changes of conductivity exhibited by the microphone are due to mere changes in the exterior points of contact. The question still remains What are these last-named changes? More than once it has been suggested in our columns that heat plays the most prominent part in the transaction—the highest temperature being at the point of greatest resistance is sensible to the slightest mechanical change, and regulates the current correspondingly. Many recently discovered facts bear out this conclusion.

Electric Lighting in the City.—The competition for lighting three large areas of the City by electric light has resulted in the Streets Committee deciding to recommend to the Commissioners of Sewers the acceptance of the tenders of the Anglo-American Electric Light Company (Brush system), the Electric and Magnetic Light Company (Jablochkoff system), and of Messrs. Siemens Brothers, for twelve months, at a cost of £5,060. This recommendation was brought before the Commissioners of Sewers on Tuesday last, but owing to the absence through illness of Mr. Blake, the clerk to the commission, and the incompleteness of the proceedings in consequence, the subject was adjourned. The next meeting of the Commissioners of Sewers takes place on Tuesday, the 16th inst.

Value of the Electric Light at Sea.—The chairman (Mr. J. Pender, M.P.), of the Eastern Telegraph Co. testifies to the value of the electric light on board ship. In a telegram from Smyrna, dated Nov. 2, he states:—"Last night (Nov. 1), the British barque "Ayrton" of Blyth, lying at anchor about 150 yards from the "Retriever" (the Eastern Telegraph Company's ship) was run into by the steamer "Lilibeo," entering harbour. The light was immediately turned on and flashed upon the barque, proving of the greatest use while the "Retriever's" boats were picking up the barque's crew. No lives lost. Boat from American man-of-war, with Commander Kennedy, was also quickly on the spot, and rendered great assistance, rigging and manning the pumps on board the barque, which was seriously damaged, and if it had been built of iron would have gone down at once."

On the Illumination of Electrodes. By R. Colley.—According to Slouguinoff (*Journ. de la Soc. phys. chim. de St. Pétersb.*), the light is intermittent which appears at electrodes (especially at a small negative one) immersed in liquids when the current is of considerable intensity. According to Colley, in a rotating mirror, a series of bright stars irregularly distributed upon a feebly illuminated ground are at the same time perceived; so that consequently the individual discharges issue from different parts of the electrode, while the time of the passage of the current is very short in

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comparison with that of the intermissions. The spectrum at a negative electrode of platinum in dilute sulphuric acid shows, when 96 Bunsen elements are employed, at first the red (bright) and blue hydrogen lines. In solutions of chloride of sodium and chloride of lithium the lines of those metals are seen in addition, and also (particularly five) platinum-lines are well seen. Only by chance is the electrode herewith so strongly heated that the liquid no longer wets it. The passage of the spark cannot be owing to this, since the electrode may be quite cold and yet luminous. In order to prove this, Colley fixes in the neck of an inverted flask without a bottom a glass tube, in the upper end of which a platinum tube is cemented, and conducts a stream of cold water through. The flask is filled up to about 1 millim. above the upper extremity of the glass tube with dilute sulphuric acid, into which a cylinder of platinum foil dips. If the platinum tube, only a small surface of which is in contact with the sulphuric acid, serves as the negative, the foil as the positive electrode, yet the light appears. From this it follows that the high temperature really falls upon the liquid surrounding the electrode, which, on account of its small surface, opposes a great resistance to the current. As can easily be calculated, a current from 100 Bunsen cells could in fact readily heat to ebullition dilute sulphuric acid (1-5) close to an electrode of 10 square millims. surface, whereupon the passage of the sparks then ensues in the vapour, while the rest of the liquid and the electrode are only secondarily heated. Even when, in a narrow aperture, sparks are formed in the liquid itself, as Righi has observed, this arises from the formation of vapour there in consequence of the great resistance and the corresponding heating of the liquid.—Wiedemann's "Beiblätter," 1880, No. 9, pp. 684, 685.—(From *Phil. Mag.*)

An Edisonian Anæsthetic.—Readers of *Punch* will remember an amusing parody of Edison's mode of announcing his discoveries, in which the parturient mountain and muscipular abortion were illustrated, and, if we remember aright, by an elaborate description of a new life-restoring beverage which proved to be an infusion of tea. Truth is stranger than fiction, or at least as remarkable, and the parody of the satirist was—unless the *English Mechanic* has hoaxed its readers and many other respectable journals—a true prophecy. Physicians have been blundering for some hundreds of years in attempts at the relief of pain by external applications, but it has been reserved for Mr. Edison to solve the problem by a stroke of genius. Those who have discovered that various substances, organic and inorganic, lessen sensibility and relieve pain, and have used them singly and in various combinations, will look with eagerness, not unmixed with misgivings, for the addition to their armamentum which Mr. Edison offers them. Their misgivings will not be misplaced. The inventor of the phonograph and of the electric lamp of the future gravely proposes as his latest invention to mix certain familiar anæsthetics together to make a new one. In the words of the *English Mechanic:*—Mr. Edison's idea is to use a compound (*sic*) of a number of the most powerful chemical substances which act anæsthetically and which have no effect upon each other. The invention further consists in placing in such compound various menstruums (*sic*) for dissolving the substances, which menstruums shall have no chemical action on each other or upon the substances beyond effecting their solution. The object of placing in one compound all of the most powerful chemicals which act anæsthetically is to ensure the action of one of them—that is to say, if one does not act the other may. The ingredients which are used are "hydrate of chloroform, ether, nitrate of amyl, morphia, camphor, alcohol, oil of peppermint, salicylic acid, and oil of cloves." Such is the precious compound which Mr. Edison is alleged to have invented. It is scarcely an exaggeration to say the discovery is on a par with that of a sportsman who should propose to load his gun at one and the same time with a bullet, small shot, and a tallow candle, so that the charge may be equally available whether his mark be a stag, a sparrow, or a deal board.—*Lancet.*

Telegraph and Telephone Wire.—At the opening of the afternoon session of the telephone convention, at Niagara Falls, Wednesday, Sept. 8th, the members listened, says the *Operator*, to an address on telegraph and telephone wire, from the Washburn and Moen Manufacturing Company of Worcester, delivered by R. K. Dana, the New York agent of the company. The address gave a rapid review of the history of wire drawing and the wire trade in this country, commencing with the first enterprise of Ichabod Washburn, at Worcester, in 1831. At that time iron wire was scarce and costly, and produced by slow processes. A few years previously a ton of English merchant wire was a year's supply for the leading hardware store in Central Massachusetts. The uses of iron wire, however, have grown rapidly. Within the past thirty years it is estimated that one and a half million miles of wire have been used as fence material, but the employment of half a million miles of wire in telegraphic transmission is an even more striking fact. The telegraph had a tardy and neglected childhood, perhaps because the world's industries were not ready to receive it, at so many points does its success touch the mechanical arts, illustrated in the history and advance of wire drawing. Copper wire has ceased to be discussed for line use. It is too soft and elongates too readily under exposure. The suitable wire must be of tough pure iron, well manipulated, to secure flexibility and toughness. Its greater electric resistance as compared with copper is compensated by increased size, which brings with it the needed requisite of strength. An iron wire of the same conductivity as copper wire has $2\frac{1}{2}$ times the diameter of the latter and 12 times its tensile strength. According to all the requisitions of leading home and foreign telegraph companies—the Western Union and the English Post Office Telegraph being cited—the iron wire must be galvanised in the best manner, for protection against oxydation as well as for the advantage of an even better conducting surface than iron itself. Authorities agree that iron wire, pure and well wrought, is called for both for telegraph and telephone use, which do not essentially differ, though the latter may use a lighter wire, No. 12 or No. 14, the former being most generally chosen. Tables were given showing the conductivity and resistance of the various kinds of iron and steel wire, of the lower grades of Bessemer and Martin Siemens steel, known as homogeneous metal. Take, for instance, No. 9, the electric resistance of iron extra B. B. being about 13·5 to about 40 for galvanised steel. The address gave a table of tests of the Washburn and Moen wire for telegraph use, made from 1853 to 1859, which are given in Shaffner's Telegraph Manual, 1859. The temptation to employ steel and urge its use in electrical transmission grows out of the fact that a very strong, smooth, and handsome wire can be made from steel at a lower cost than iron wire, seeming no better externally. The electrical tests as above demonstrate the economic difference. The address was well received, as a careful discussion of wire from an authoritative source, and the convention voted to incorporate it in the printed proceedings.

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

(CONTINUED FROM PAGE 262.)

LECTURE V.—DELIVERED FEBRUARY 30, 1880.

Ebonite or Vulcanite. Its manufacture. Chemical and Physical properties. Applications in the useful and ornamental arts. Substitutes for india rubber.

The fact that rubber becomes hard and hornlike when the operation of vulcanisation is carried on to an extreme degree, was recognised by Hancock in his earlier experiments concerning vulcanisation; but it was not for some years afterwards that the industrial importance of hard vulcanised rubber was duly recognised.

Between the years 1848 and 1850, Charles Goodyear produced some fine specimens of ornamental work in the material in question, and these fully demonstrated the industrial value of vulcanite or ebonite; proving conclusively that the most delicately modelled objects can be faithfully reproduced in hardened india rubber.

I am indebted to Mr. Sexton, for the opportunity of showing to you a unique collection of Goodyear's earlier specimens, these being of a character calculated to surprise some of those who judge of the possible developments of the ebonite industry by those articles which are now met with in the ordinary channels of trade.

Hard vulcanised rubber is produced by exaggerating the conditions of ordinary vulcanisation, or increasing the proportion of sulphur added, and lengthening the period during which it is allowed to react on the rubber. The temperature at which the operation is conducted may, in some cases, be slightly elevated over the heat usually employed in the case of ordinary vulcanisation; but this course is more or less liable to lead to the production of unsound or spongy ebonite, and those who are most successful in the regular production of goods of the highest quality seldom employ a temperature above 135° to 140° Centigrade.

The sorts of rubber best adapted for the production of ebonite are those hard and fibrous kinds which are yielded by the islands of the Malayan Archipelago; and that obtained from Borneo is generally considered to be exceedingly well adapted for the purpose in question. Rubbers of the African tongue order are not adapted for the ebonite manufacture, while the high-priced Para rubber yields an article inferior to that obtained by making use of the lower-priced rubbers first mentioned.

Before proceeding any farther, please be good enough to notice this strip of rubber, which has remained in the melted sulphur bath during the last three hours, the temperature having been maintained near 140° during the greater part of the time. It has, probably, absorbed as much as 40 to 50 per cent. of sulphur, and has altogether lost its extensibility by tension; while its colour is somewhat darker than that of ordinary vulcanised rubber.

As regards the industrial production of vulcanite, the sulphur bath method is inferior to the more certain process of mechanical admixture and subsequent curing.

The rubber intended for use in the ebonite manufacture requires careful purification, and the ordinary washing process, as already described, is occasionally considered to be insufficient. In such a case it is supplemented by a kind of deviling operation, which consists in tearing the rubber into shreds under water, after which it is soaked in an alkaline solution. The purified and carefully dried rubber is next mixed, by means of the usual heated rollers (Fig. 15, p. 196), with a proportion of sulphur, which may range from 50 per cent., when hardness is required and a slight degree of brittleness is not considered a disadvantage, to 25 per cent. when elasticity and comparative softness are wished for. It is important that the sulphur should be dry and free from acid, and that the materials should be thoroughly incorporated. About 3 per cent. of lamp black or vegetable black is often added, in order to improve the colour of the finished material, and a similar proportion of calcined magnesia is also occasionally added.

During the incorporation of the sulphur, the material becomes remarkably plastic, and appears to lose almost all traces of elasticity, so that it can be calendered into sheets with very great facility.

Ebonite is usually cured in steam, at a temperature of about 135 deg. Centigrade, the operation lasting during a period of 6, 8, or 10 hours, according to the thickness of the articles or other circumstances, but if the temperature is gradually raised to 140—150, during the progress of the operation, a much shorter time may suffice. Under any circumstances, it is unadvisable to apply the full heat at once, but first to set the material, by commencing the vulcanisation at a moderate temperature.

The articles built up or made of the soft material, generally require more support during the operation of curing than is afforded by embedding them in powdered French chalk.

In the case of ebonite sheets, the support usually consists of plates of tin, these being made by rolling together a number of thicknesses of tin-foil. By thus vulcanising the ebonite between sheets of tin, a surface is produced which is so smooth as to be almost polished, while a similar end may be attained by using glass plates for a like purpose; an extremely thin film of grease, or preferably wax, being applied to prevent adhesion.

Several distinct stages or steps may be traced during the curing of ebonite; and I wish to call your attention to some specimens illustrating these various stages.

Here, in the first place, is the plain mixture of sulphur and rubber, this being nearly white, and capable of becoming quite plastic or soft by the application of a gentle heat.

The second specimen illustrates the action of a very moderate degree of heat on the mixed material, this particular sample having been heated to 128 deg. Centigrade for twenty minutes. It is, as you see, somewhat darkened, and has lost a little of its original softness; while a degree of heat which would have rendered the original mixture plastic, like putty, fails to make much impression upon it.

The third specimen illustrates the effect of a more prolonged heating, this sample having been heated for an hour to 135 deg. Centigrade. It is olive green in colour, and has acquired a certain amount of elasticity, resembling that of a rather inferior quality of vulcanised caoutchouc.

The fourth stage of curing is illustrated by this specimen, which you see is brown, and tolerably hard. Ebonite in this state refuses altogether to become plastic by heat, and a temperature of 150 deg. maintained for half an hour or less would suffice to bring it to the fifth stage, or that of finished ebonite.

The fifth stage, or that of properly-cured ebonite, is the goal to be arrived at in manufacturing the material. There should be no places where the curing is imperfect, a kind of defect which is likely to happen when articles of unusual thickness are vulcanised, and no portion of the ebonite should be spongy or honey-combed by air bubbles.

The sixth, or spongy state, is generally the result of overheating, bubbles of gas forming in the material, and converting it into a kind of porous cinder-like mass.

A specimen will now be handed round, which illustrates the third, fourth, fifth, and sixth stages, as already described. The specimen in question was cured on a hot-plate, this having probably been heated to 160 deg. or 170 deg. Centigrade; and you will be able to trace all gradations in the curing operation, from the first setting of the plastic material to the destruction of the ebonite by over heating.

A study of the sample in question points very clearly to the propriety of curing ebonite at a low temperature, especially when articles of a similar thickness are operated upon, as the long continued moderate heat tends to ensure equal action through a considerable mass. Very small or thin articles may be cured rapidly without much chance of mischief arising. It very often happens that when thick articles are required to be made of ebonite, it is found convenient to build them up layer by layer, and cure each before adding another. New material adheres very perfectly to old, and unites thoroughly during vulcanisation, provided that the old has not been so far cured as to become extremely brittle, and that it is well roughed up before the fresh material is applied. A little of the mixed, but uncured, ebonite may be softened by benzole, and well rubbed over the place where additions are to be made.

The working of the soft, mixed ebonite, before curing, is a very easy matter, as it can be moulded into any form, and pieces of it may be united by warming the edges, or by smearing them with a solution or paste, made by dissolving some of the mixed material in benzole.

Moulds of tin, of brass (tinned inside), or of type metal, answer very well; the application of a trace of oil, followed by a thorough brushing with black lead, being an effectual preventive of adhesion between the finished material and the mould. In building up complex articles of ebonite, the usual method is partly to vulcanise or cure the main portion, bringing it, say, to the fourth stage already mentioned, and then to make the required additions. Many articles can be advantageously cured in moulds of plaster of Paris; and I believe that several of the finely modelled specimens of Goodyear's work now before you were made in plaster moulds.

Casts of phototypic reliefs can be made of ebonite; the mode of procedure being quite similar to the making of the soft india rubber casts. One or two of these, together with the type metal moulds, and the corresponding negatives, will now be

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handed round. Tubes are generally made on mandrils, the soft ebonite being wrapped round these, and then supported by a wet cloth bound over.

When ebonite is heated to a temperature of about 100 deg. Centigrade it can be bent to a certain extent, as the heated strip serves to illustrate; and, on cooling, it retains the form given to it. The spiral bracelets which you see on the table are manufactured straight, and afterwards bent while warm. In a similar manner an ebonite disc, when slightly warm, may have a device struck upon it coin fashion. This can be very well illustrated by means of the small striking press which is now before you. Notice how readily the warmed ebonite takes an impression of the die, but the pressure required is considerable, and the device is not very permanent, as on warming such a coin or medal, the ebonite recovers from the state of tension into which it was put by the operation of coining, and the image disappears. The Silvertown Company manufacture large numbers of ebonite coins and tokens, these being principally made use of in the South American States, and a collection of these is now before you. These coins are struck up by repeated blows, produced by a press so constructed that one spoke of a loose fly wheel, which is worked by hand, shall strike against a driver attached to the screw of the press. This arrangement renders it easy to force down the screw by a series of blows. Let me now heat a few of these coins over the flame of a gas stove, after which the resulting plain discs shall be handed round, together with coins similar to those which were heated.

You understand, then, that in case of these coins, the low level parts exist in a state of compression, and are ready to rise up to the level of the other portions as soon as the application of heat enables the molecules of ebonite to take a position of equilibrium. Consider now the effect of planing one of the coins, so as to reduce the projecting points to the level of the compressed parts; and then heating the blank thus obtained. You shall see for yourselves. Here are some coins which have been so rubbed down, or planed. On heating them the compressed parts rise up, and the device reappears in *intaglio*, with all the detail of the original. We have, in fact, a reproduction of the original die, only it is reversed as regards direction—the left hand becomes the right, and *vice versâ*. Here is a coin, one side of which has been rubbed down level, while the other side is untouched, and on heating this the device will disappear from one side and re-appear in *intaglio* on the other side.

(TO BE CONTINUED.)

PROGRESS AND COST OF ELECTRIC LIGHTING IN AMERICA.

BY PAGET HIGGS, LL.D.

(CONTINUED FROM PAGE 227.)

As regards the cost of the Brush system of electric lighting, some very instructive figures have been given by several consumers who have had the light in use for more than a year, and it is noticeable that the unanimous opinion is in favour of electric lighting. The most advantage accrues to the manufacturers and dyers of coloured goods, who are enabled to work continuous shifts, and who in some cases state that, especially during the summer months, the night work by the electric light is better performed than the day work by the sun's rays. Some of the sorters of coloured worsteds and cottons with whom the writer has conversed have stated that it is easier to match and distinguish colours by the electric light than by daylight, for the reason that nearly similar shades have greater individuality. Such a verdict has been practically supplemented in one instance by the use of the electric light in the chief sorter's room by day as well as by night.

Another reason why the electric light is preferred is that no increase of temperature is experienced in the atmosphere of the work rooms, a valuable fact, not only on account of the comfort and health of the work people, but also in many cases actually remunerative to the proprietor in that the temperature of his vats or other utensils of manufacture is unaltered. In the Willimantic Cotton Mills, the largest concern of the kind in the Eastern States, before the introduction of the electric light, the temperature of the room was raised 12° Fahrenheit, with gas, immediately after lighting up. But with the electric light there is no increase that can be measured. This establishment has (amongst four other machines) one machine and 18 lamps, furnishing light in place of 450 gas burners. One lamp illuminates the saw-mill (40ft. × 60ft.). The man in charge of the lights, which were instituted Feb. 1, 1879, never before saw an electric light nor generator, and states that in one day he acquired the requisite knowledge.

The light is in use by the New Jersey Steel and Iron Company, as well as by the Phœnix Iron Company of Pennsylvania. The latter concern illuminates its machine shop (317 × 90 × 38 feet high) and its column shop (130 × 53 × 13 feet high) by 11 lamps, replacing gas jets that cost 11·25 dollars (= 45 shillings) a night of 12 hours. The light is better, and costs now, including power, attendance, and carbons, only four dollars (= 16s.) a night.

Allen Brothers, of Sandy Hill, New York, state the cost to be one-fourth, with the electric light, of what this firm were formerly paying for gas.

At the Riverside Worsted Mills the Brush light was instituted on the 20th February, 1879, one machine being first set up. A second machine was started in March, and a third in April. These three machines were run with such satisfaction that in September two more were put up, making in all five machines running 80 lamps, now lighting regularly nearly all the principal rooms. It is a great advance in the utility of the electric light to find that these extensive users say that they "have not had a moment's delay from, nor a dollar's worth of repairs on any of the machines or lamps." The actual cost is thus given *by the consumers*:—

Consumption of carbons per hour.....	89 cents.
Power used for machines.....	65 cents.
Interest on cost of machines, &c. ($1,500) ...	30 cents.
Attendance, oil, wear and tear, &c.	36 cents.
Total cost an hour	$2·20 or 8s. 10d.

There are 578 gas burners that would be lighted were the electric lights stopped. Estimating these burners at 6ft. per hour, there would be 3,468 cubic feet of gas per hour burnt; and as gas costs in America two dollars (or 8s.) a 1,000 feet, the cost has been 6·93 dollars (= 27s. 10½d.) per hour, but with a vastly inferior light. These consumers thus calculate that the saving of $4·73 an hour for the 3,000 hours run in the year being $14,190, that the machines have paid for themselves.

The consumers further say, "These figures are *actual*, as we averaged the number of carbons burned for several nights to get the exact consumption of each lamp, and for the consumption of gas we took off a number of the gas burners in use, had them tested on a test meter, and averaged them, getting a strong six feet to each burner."

It would be impossible to find more valuable information than the foregoing as to the practical cost of the electric light, and as to its efficiency.

It has been urged against the electric light that it cannot be substituted for gas in places of public assembly where there is public speaking, on account of the noise or hissing sound of the voltaic arc. This hissing sound is neither more nor less than a defect in the lamp, and occurs chiefly with those lamps worked by machines producing great volume or quantity currents. In the North Orange Baptist Church, New Jersey, are two lamps taking the place of 318 gas burners, with a difference of temperature of 8° to 10° F. in favour of the electric light.

The light is also largely used in America for hotel purposes. The Grand Pacific Hotel, Chicago, has it, and also the Continental Hotel in Philadelphia, where the cost is stated by the proprietors to be 1 cent. (= ½d.) each lamp an hour. Six lamps are used, replacing gas burners that formerly cost $20,000 (= £4,000) a year—not a small gas bill.

At the Palace Hotel, San Francisco, two machines are employed, one absorbing 3 H.-P. the other 6 H.-P. The lights are thus distributed:—Two 3,000-candle lamps in the court yard, displacing 510 gas jets; two 1,000-candle lamps and one 3,000-candle lamp in the dining room, displacing 280 gas jets; one 1,000 candle lamp in the restaurant, replacing 150 gas jets; one same in the office, that replaces 100 gas jets; another same in the kitchen, displacing 20 gas jets; and another in the bar, displacing 25 gas jets; a 3,000-candle lamp at the front of the hotel completing the list. We have thus 18,000-candle light with an expenditure of 9 H.-P, 15,000 candles of which displace 1,085 gas jets, or 17,360 candle light as represented by gas; yet the electric light gives far more illumination. Even taking gas at 75 cents. (= 3s.) a 1,000 cubic feet the cost is 4·88 dollars an hour (or 19s. 8d.) against what is comparatively a nominal cost for the electric light. At the actual price of two dollars a 1,000 feet, the gas bill is, with every care for economy, more than double the amount stated.

That the electric light is making progress is undoubted, and we have again in this instance to admire American ingenuity and talent which has, even in competition with our best Continental and English makers, succeeded in wresting an order for 500 lamps from our own naval authorities. It is quite certain from the foregoing figures, which are it is to be again stated the consumers' figures, that electric lighting is not yet understood so well by English as by American manufacturers. Therefore, our scientists must "lay not the flattering unction" that they have fully discussed the question.

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ELECTRICITY AND VEGETABLE LIFE.

Some recent experiments with a view to utilising electricity for the purposes of horticulture and of agriculture have awakened a long dormant interest in the mystery of organic life. As far back as the middle of the last century there arose a strong impression that the observed effects of the electric shock upon living as well as inanimate things afforded some evidence that life was sustained, or at any rate greatly influenced, by electrical agency. Many were the experiments which sought to establish this connection, and great was the controversy that ensued. But satisfactory as the results appear to have been to the experimenters themselves, nothing was certainly arrived at worthy of preservation as a scientific fact; and perhaps the only dogma which has survived on this subject to the present day is one which perennially asserts itself in the advertising columns of the newspapers that, beyond all manner of doubt, "electricity is life."

Looking back to the records of the period to which we are referring, we are struck with the inconclusiveness of the testimony which appears to have satisfied our forefathers. That a gentle electrical stimulus—whatever that may mean—affected vegetable life in some way or other was perfectly certain; but the how or the why remained inexplicable, and for one piece of evidence showing that the effects were beneficial there was always another telling rather that they were injurious. The one certain fact was that an electrical shock was capable of paralysing and even of destroying organic matter. Electrical fluid, we are told, caused to pass through certain plants killed them instantly, and branches of trees were sterilised in that way; animals, too, could be killed by a violent electrical shock—facts which the familiar effects of lightning had, one might have supposed, sufficiently demonstrated already. On the whole, indeed, the general drift of the evidence pointed to the conclusion that electricity was not life, but rather that it was death.

In several quarters, however, it was maintained that though destroyed by excess of electricity, vegetation was nourished by it in due quantities, and that, artfully applied, it would assist the growth of trees and expedite the ripening of fruits. It may surprise our readers to learn that experiments almost identical with some of quite recent date were tried a hundred and twenty years ago, and we are sorry to have to add that nothing came of them. The Abbé Bertholon, among others, pursued electrical horticulture for a considerable time, and when we state that he erected a large number of conducting rods, and distributed the electricity so collected by means of metallic spikes all over a garden of growing vegetables, his boldness and enthusiasm cannot be questioned. Everything grew to the Abbé's satisfaction; but later experimenters deny that the spikes or the rods—or presumably the electricity—had anything to do with it. A countryman of the Abbé's has lately been making similar trials; but in the intervening years, except in relation to therapeutics, little or nothing of value has been discovered concerning the action of electricity either in or upon organic life.

M. Grandeau whose investigations were recently brought to the notice of our readers,* has adduced some more trustworthy evidence than that which we have been citing in support of the theory that atmospheric electricity is a principal factor in vegetable production. Not being satisfied with the commonly received explanations of the disappearance of the underwood in dense forests he arrived at the conclusion that it was due to the loss of electricity by reason of the trees overhead acting as a natural electrical screen. This of itself does not look very promising—at all events for the improvement of arboriculture; it only shows that the trees know very well what they are about, and that if you want trees and not jungle you must let the superior creature have its own way. But M. Grandeau tried the screening of plants, not under trees, but under wire network, and he found that the growth thus caged was impaired and delayed. This and the known fact that vegetation takes a sudden bound after a thunderstorm are, in the main, all the evidence we have upon which to rest the assertion that electricity has, in any exclusive or direct way, an important part to play in the functions of vegetable life. We do not remember having heard of experiments applied to the roots instead of to the leaves of vegetables, and we think there is room for a trial in that direction. Some data might be collected from the millions of spots where earth-wires enter the ground at the foot of telegraph poles; and but for the possibly disturbing effect of chemical action aquatic plants might be easily operated upon. We do not pretend that there is anything practical about these suggestions; we are dealing with a subject which most people still continue to call fanciful, and we are therefore at liberty to exercise our imagination in dealing with it. A writer in these columns not long ago told us that wires carried by small balloons or bladders to a considerable elevation would steal sufficient atmospheric electricity for gardening purposes, and that the neighbourhood of the plants might be saturated with electricity in much the same way as

* Electricity and Agriculture. *The Electrician*. July 24, 1880.

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that pursued by the ingenious Abbé Bertholon. This mode of "hastening the development of vegetation" was described as "easy." We say nothing as to that, but we are sure that the idea was heroic.

Turning now to the electric light which has lately, for the first time, been used in the practice of horticulture, we come upon what is seemingly a more hopeful class of experiment. At all events, something has actually been done, and certain results, so far as they go, have been obtained. Dr. Siemens has found that fruit and flowers have thrived exceptionally well when the light of the electric lamp has supplemented at night the rays of the sun by day. The indefatigable doctor has not yet pursued his investigations for a period long enough to demonstrate that darkness is unnecessary or inimical to vegetable life, but he has shown that under certain conditions and at certain seasons the light obtained from electricity is a help and protection to indoor and outdoor plants. The precise nature of the electric rays and the part they play in the business have yet to be determined; but at present it is by no means clear that an equally pure and brilliant light, were it obtainable from any other source, would not do quite as well. In any case it is not alleged that electricity, as such, has anything to do with the increased vitality apparent in the objects exposed to this form of light. The enthusiasts of what may be called the old school will, therefore, probably take exception to Dr. Siemens' experiments as not being electrical horticulture at all. What would satisfy them better, we imagine, would be a charged atmosphere without the light—the electric arc, but no illumination. The electric light in this relation is a mere matter-of-fact adjunct like the glass roofing of a hot-house, say they, and is as common-place as the matting coverings for wall-fruit. Whereas electricity directly applied to vegetation is something quite different — something occult; and although quite easy and practicable, it is not to be lightly explained. The curious experimenters of the last century attached much meaning to the "smell" of electricity, conjecturing that the odour always noticeable in the vicinity of electrical discharges, and which we now respectfully call ozone, was, in truth, the vital essence they were seeking to utilise. If this were so, we are sure that Dr. Siemens, even with the limited machinery and appliances available at his country residence, would be able to make smell enough to satisfy not only the requirements of his own gardener but of every gardener in Tunbridge Wells. There is a great deal yet to be learnt about electricity, and especially about its functions in the economy of vegetable life. The paucity of useful information on the subject is apparent from what we have related above. That something pecuniarily profitable might come of further investigation just now is, perhaps, our best hope of seeing it pushed forward with more diligence and discretion.

ATLANTIC CABLES.

We have made careful inquiries as to the authenticity of the news in the paragraph which appeared in the *Standard* of October 26, and which we commented upon in our last issue, but our efforts have failed to enable us to ascertain anything of the company. The following paragraph, which appeared in the *Daily Telegraph* on Wednesday, November 3, entirely confirms our experience:—

"The following refers to the rumour lately published here of another Atlantic Telegraph scheme, American in origin. Rumours to this effect recur pretty regularly once a year, with no other effect than a slight temporary depression of the market for the existing companies' stocks. In the present case some vague gossip at New York seems to have been the only foundation for the story:—

TO THE EDITOR OF 'THE DAILY TELEGRAPH.'

SIR: As shareholders and friends of shareholders in the Direct United States Cable Company, we cabled to our correspondents in New York to know whether there was any truth in the report cabled to this side to the effect that 'a new American Cable company had been formed and was supported by eminent bankers and prominent capitalists in Boston, New York, &c.,' and the following is their reply: 'Nothing known here about new cable.' We enclose names of our correspondents in New York, who are well known and have been long established there.—Yours obediently,

SHAREHOLDERS."

CORRESPONDENCE.

WHAT IS ELECTRICITY?*

TO THE EDITOR OF THE ELECTRICAN.

SIR: As you have republished my letter of 1839 I hope you will allow me to give some historical information about it. On the original publication of it I procured a number of copies of the newspaper, and having marked the letter and folded the newspaper so that all who received the copies would on opening them see the purpose for which they were sent, I despatched per post a copy to each of the scientific men whose addresses I had obtained, and whom I knew to be taking an interest in electrical experiments. Faraday and Arago got copies, also each of the professors of natural philosophy in the various Universities. Of these gentlemen the only one who replied was the late Professor Johnston, of Durham. He was no relation or acquaintance of mine, yet he sent a very kind letter acknowledging receipt of the paper and encouraging me to go on with my experiments. I called upon Dr. Ure, professor of chemistry in Glasgow; he said he had read my letter, but excused himself from repeating the experiments from want of time. These facts establish that my experiments and theory of one electric fluid were known to most of the prominent electricians forty years ago. At that time the *Quarterly Review's* pun, "Faraday is near a Knight" was not concocted. Mr. Faraday had gained the ear and the confidence of the scientific world through his numerous discoveries in electricity, which he was then making, and I saw that it was in vain at that time to urge on the public my theory of one fluid. However, I believe that the time has now come when at least some scientific men will give heed to it.—Yours, &c,

JAMES JOHNSTONE.

Craiglockhart, Hydropathic, Near Edinburgh,
October 25th, 1880.

THE INDIAN TELEGRAPH DEPARTMENT.

TO THE EDITOR OF THE ELECTRICIAN.

SIR: In your issue of the 14th ult., under the heading "Telegraph Miscarriages at Calcutta," you reprint a paragraph from the *Statesman* reflecting on the Indian Telegraph Department. That paragraph is an utter misrepresentation of the facts of the case. The facts of the case are as follow:—A counter clerk with seventeen years good character stole some messages after transmission, took off the defaced stamps, and tried to use these stamps a second time and defraud Government of their value. *In the ordinary course of business* the fraud was discovered, the man was arrested and sentenced to six months' hard labour. As the accused had given security the value of the defaced stamps was duly recovered, and Government lost nothing excepting costs of the prosecution. The case really demonstrated the efficiency of the system of check.

TRUTH.

ON ELECTROLYTIC POLARISATION.

BY THE COUNT DU MONCEL.

The discussion which is now going on in *The Electrician* between Mr. Desmond FitzGerald, M. Exner, Mr. Brown, and others has shown me that these gentlemen have only taken into consideration one side of the question, and that they have not in any manner dissected the phenomenon, which is much more complicated than they seem to think, and which evidently cannot be formulated as M. Exner indicates.

In order to study electrolytic polarisation well, it is necessary

* This letter was crowded out of our last issue.—[ED. *E.*]

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to analyse the effects separately, not only at the electrodes, *but even in the body of the electrolyte itself*, and with different conditions of conductivity of this medium it is necessary to be able to *displace the electrodes without making them lose their polarisation*, to make them react upon neutral electrolytes, and to examine what the electrolytes themselves can produce after electrolysation. But it is only with minerals, and particularly with silex, that one can obtain this result.

I have studied these phenomena for a considerable number of years, and I am astonished that the *savants* above mentioned have not known of the important results I have obtained, and which are stated in a series of memoirs published in the *Comptes Rendus* of the Academy of Sciences between 1872 and 1877, and methodically summarised in a long work inserted in the *Annales de Phisique et de Chemie* for 1877.

Although I do not wish to pronounce upon the theory of the phenomenon of polarisation, which is very complex, I have thought that it would be useful for the readers of *The Electrician* to know the results of my researches, and I have consequently made the following summary :—

My experiments have been made with several minerals, but chiefly with plates of silex or flint of a remarkable conductivity* for a stone so hard and susceptible of a fine polish. These plates were otherwise endowed with quite peculiar hygrometric properties. Analysed by M. Damour, to whom I confided the stone, it was composed as follows :—

	Gramme.
Silicon	0·9664
Aluminium	0·0048
Ferric oxide	0·0051
Chalk	0·0034
Water and volatile matter	0·0200
	0·9997

A fragment of this flint, says M. Damour, weighing 6·0510 grammes, having been exposed to dry at a temperature of + 65° to 70° C, had lost at the end of an hour 0·0560 gr., after four hours 0·0600 gr. On being exposed to the open air it recovered in twelve hours 0·02500 grammes, and after three days 0·03700 gr. Placed upon a glass bell above a vase containing water it recovered after twenty-four hours its original weight of 6·0510 gr., and even exceeded it by 0·1350 gr., the total weight 6·1860 gr.

It results from this hygrometric property that silex or other bodies of this kind traversed by an electric current and put in relation with a galvanometer will indicate variations of humidity in the atmosphere at different hours of the day. I insist upon these conditions of the conductor of which I speak in order to make certain that its conductivity is electrolytic. Here are now the results of the effects of polarisation which are proved, and which are very different from those obtained with ordinary liquid electrolytes.

If we pass across the silex in question the current of a battery of 12 Leclanché elements, taking as electrodes plates of platinum well heated in a flame (flambé) and very clean, we find, after having withdrawn the battery from the circuit and connected the electrodes to a sensitive galvanometer (of 30,000 turns), the following results :—

1. A polarisation current is produced *of which the intensity and duration increases with the time of electrification of the stone*, and which attains 86° after ten minutes' circulation of the battery current, enduring for from 25 minutes to several hours, according as the stone has been electrified once or several times running in the same direction, even although the polarisation current was allowed to disappear after each electrification. Thus for three passages of the current of 32 seconds each I have obtained the following results :—

	Principal intensity of current.	Current of polarisation.	Duration of polarisation current.
	Deg.	Deg.	Min. sec.
1.	64	55	13 15
2.	62	60	22 40
3.	60	62	29 10

We will see later on the effects which are produced when we reverse alternatively the direction of the polarising current.

2. The phenomena of polarisation produces it in a double manner, that is to say, *on both electrodes*, and *on both parts of the electrolysed body in contact with them*, in such a manner that the principal current *creates*, by reason of its circulation across the stone, *two distinct electric generators*, which are susceptible of producing of themselves currents of polarisation. To convince us of this it is sufficient to withdraw, after some minutes electrification of the stone, the two electrodes of platinum, and to place them upon a flint not electrified and connect them to the galvanometer; we then get a current more or less strong, according to the conditions of the experiment and the time of electrification. To prove the current of the stone we envelop the parts to which the electrodes were applied with plates of very thin new platinum, and discover a new current, of which the intensity *depends upon the conditions of the experiment*. What is curious in these effects, and is not encountered when we make the experiments with liquids, is that we can *handle these electrodes and the stone during a certain time without destroying its exciting properties*, and they can even remain for a long time separate without losing these properties. This time depends, for the rest, on the duration of the polarising current.

3. It is rare that the polarisation currents furnished by the electrodes and the stone have the same intensity, and the predominence of one of these currents over the other depends on the time of electrification of the electrolytic system, and on the nature of the electrolysed body. If the body has only an electrolytic conductivity like the silex in question, the current of polarisation furnished by the electrodes is for one passage of the principal current of short duration (five or ten minutes) *much higher than that of the stone, but the inverse takes place if the principal current has passed during a long time*, a half hour, for example, or if one has effected a great number of experiments running, and in the same direction. With a stone which possessed, besides electrolytic conductivity a metallic conductivity, such as red hematite iron ore (*fer oligiste*) for example, it was no longer the same, and *it is the current of the stone which is of much more consequence than the current of the electrodes;* it is even necessary to prove this last to have recourse to an intermediate conductor, having a conductivity strongly electrolytic, like the silex of Heronville or distilled water.

4. The polarisation current furnished by the electrodes is due, without doubt, to the action of the condensed gas, for, to obtain an indication of this current, it is necessary to connect the two electrodes which have served for electrification of the stone *by a body possessing a marked electrolytic conductivity*, either a second flint or some liquid not electrised. If one connects these electrodes by a decidedly metallic plate, like hematite or magnetic iron ore, no current is produced.

5. The current of polarisation furnished by the electrolysed body has a more complex origin, and can proceed from a condensation of gas effected upon the particles of the bodies which possess a conductivity of their own, or from an electrostatic polarisation which these different particles have acquired under the influence of an electric condensation brought about by the electrodes, from which results a discharge current analogous to that from a condenser when the armatures are connected.

6. *The part taken by each of these two electrodes in the creation of the current of polarisation is far from being the same;* the action is infinitely more energetic at the *positive electrode* than the negative, and therefore the simultaneous action of both electrodes gives to the phenomenon a very superior development to that which will result from their individual actions simply added. This difference of action varies with the duration of the passage of the principal current, and it is much greater as that duration is longer. *However, it only takes place at the positive electrode, for at the negative electrode the effect of polarisation attains very quickly a maximum which it rarely passes.*

7. The property that the electrodes possess of furnishing a polarisation current after having been electrised by the intermediary of a stone is preserved, as I have said, for a long time, *and is not destroyed by wiping*, as happens when they have served for the electrification of a liquid. But *if one wets them the wiping depolarises them as well as if one had heated them in the flame of a spirit lamp*, at least if one takes in order to reveal their electric state, a non-electrised flint.

8. If upon a non-electrised stone one applies electrodes of platinum plunged during a long time in oxygen and hydrogen gas, or if one blows around them jets of these two gases one obtains no current, hence one can conclude that the phenomenon of polarisation cannot be completely assimilated to that of a gas battery, as is generally supposed. On the other hand, if one separately electrises the electrodes by means of a Ruhmkorff coil, so as to make them the two arms of a condenser, and if one applies them afterwards upon the stone, one does not get any more current, and one can conclude that this phenomenon of polarisation is not due exclusively to an electrostatic polarisation. In order that this phenomenon should produce itself it is necessary, then, that the system constituting the electrolyte is at the time electrised, and arranged in such a way as to have condensed gas upon its electrodes. In these conditions it is the electric action which determines the chemical action, and it is afterwards that the latter reacts.

9. From the passage of a current across middling good conduction there results such a polarisation of the molecules composing it that, even after all the polarisation current has disappeared, *its action still exists in the electric effects which succeed.*

* The resistance of this stone was about 17·540 ohms.

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10. If after having passed during a long enough time a current across an electrolyte one makes it pass in a contrary direction during a much shorter time, the polarisation current which is set in after this second electrification corresponds to the last direction of the principal current which has traversed the electrolyte, *but it does not last, and at the end of some instants it disappears to give place to another in the contrary direction, which corresponds to the first electrisation of the electrode.* This effect is general for all electrolytes formed of bodies simply humid, and even for liquids only produces gases after electrolysation, or for dielectric bodies like gutta percha ; but it is much more distinct and more easy to analyse with the silex in question. In studying separately the currents produced in this case by the electrodes and the stone, one recognises, at least after a sufficient period of electrisation, *that the polarisation current experienced in the first case is determined by the electrode, and that the second proceeds from the electrised body itself.* Hence it results that two contrary electric polarities can develop themselves side by side without neutralising one another.

11. The ordinary consequences of the effects of polarisation are, as is known, a successive weakening of the current transmitted. Nevertheless, with middling good conductors like our silex, it is not always so ; and when the humidity is sufficient the current in question *augments always in intensity with the closure of the circuit.* When, on the contrary, the body is very slightly humid it rapidly weakens, and even ceases altogether at the end of a very short time with certain porous stones. Again, one remarks that the current increases in power when it traverses the body in a certain direction and decreases for the opposite direction. For the rest these effects depend largely on the intensity of the polarising current. If this current is feeble its intensity decreases with the duration of the closure of the circuit, but if it is strong it continues to augment. I explained these different effects in my memoir upon the conductivity of middling conductors (p. 51). The same observations apply to liquid electrolytes, according as they are good or bad conductors.

12. The electric action exercised upon currents successively transmitted across a body of medium conductivity of the same nature as the flint varies according to the direction in which the currents succeed and the degree of humidity of the stone. If the stone is humid and the closures of the current are effected in the same direction at regular and close intervals the current does not seem to change sensibly in intensity. When the stone is drier the intensity of the current decreases at each new make of the circuit as it would have diminished had the current been continuous. With alternating currents, when the stone is humid their intensity diminishes, but this weakening is less and less marked as the reversals are multiplied when the stone is a little humid ; each reversal has the effect of reinforcing at the beginning the intensity of the current ; but it happens oftener that this intensity is greater for one direction of current than another, owing almost always to the presence of local currents in the stone.

13. If to study the effects which pass in the inside of middling good conductors, we superpose one silex over the other in the above experiments, and places between the surfaces in contact two platinum electrodes under exterior electrodes enveloping the two extremities of the system, the current which traverses the semi-conducting mass from one extremity to the other will polarise the two interior electrodes, although not metallically connected, and *their polarity will be diametrically opposite* to that of the exterior electrodes corresponding to them. It follows that the polarisation currents furnished by these two systems of electrodes are in opposite directions to each other, and that in reacting on one another reciprocally to grow less. This reverse polarisation of the two system of electrodes proceeds, as we have already seen, from the fact that the electrodes which are not in direct relation with the battery constitute with the two other different voltametric systems, interposed on a derived circuit, springing from the electrodes put in connection with the battery, and completed by the stone comprised between the two other electrodes. On the other hand, the electrodes put directly in relation with the battery constitute between them a simple voltametric circuit which should determine the most energetic effects, since the resistance interposed in that part of the circuit is less than the sum of the resistances interposed in the other part, and since the current has then only traversed a single electrolytic system instead of two.

THE ELECTRIC LIGHT.

The report of the committee of jurors on electric light appliances now on view at the Philosophical Society's Exhibition at Burnbank will be looked forward to with much interest by the general public, as well as by the scientific world. There have been no fewer than four electric lighting firms engaged in taking part in the competition, three of which have attained a considerable prominence in connection with the new method of artificial illumination. The "battle of the lights" is being waged with great fervour on the part of these competitors. Almost every day for the last two or three weeks there has been added to the exhibition some new lamp or dynamo-electric machine, or some other important improvement by which the inventor hopes to outdistance his competitors in the race of "rivalling the sun."

Two distinct classes of lighting systems are shown in operation—first, those whose advocates pin their faith to a single large machine for generating the electric current to supply a number of small lights ; and, secondly, those which consist of a group of smaller machines, each of which gives an independent current for one or two lights only. The advantages of the first class urged by their advocates are the supposed greater convenience and manageability of a single machine to attend to. The persons who favour the second class contend—and, it must be confessed, with some truth—that the fact of being compelled to trust the entire lighting of an establishment, or railway station, or line of streets to one machine is something like putting all one's eggs into a single basket, the chances being that any slight accident or derangement is liable to occur equally to the large generator as to each of the small ones, with the obvious difference that in the latter case one or two lights only would be extinguished instead of the whole district being put in darkness.

The collection of exhibits shown by Messrs. R. E. Crompton and Co. comprise sets of apparatus belonging to the second class. On their stand, No. 136, there are shown a number of Mr. Crompton's regulating lamps, which have been successfully adopted in many parts of the United Kingdom, in America, and on the Continent. The principle of the Crompton lamp, so far as it can be described in the space at our disposal, is the more regular and equable manner in which the supply of the carbon is controlled, with the result that the burning of the carbons goes on with extreme steadiness, and with much less flicker, or that disagreeable change of colour which is so trying to the eyes. Briefly, Mr. Crompton has attained his end by separating the movement which advances the carbon rods as they are consumed from that which maintains them at the proper distance apart necessary to form the electric arc with the desired exactitude. On the same stand are shown the necessary fittings and accessories which this new branch of lighting has rendered necessary. These comprise instruments for measuring the electric current, as well as commutators, switches, resistance coils, and other apparatus more interesting to the technical observer than to the general public. The lanterns for enclosing the electric lamps have been designed with a view to give the maximum of light with the minimum of shadow. A complete set of portable apparatus for supplying four large lights collectively of 24,000 candle-power is placed at the end of the Drill Hall. This set of apparatus is capable of lighting thoroughly and brilliantly a hall or railway station 400ft. long by 150ft. wide.

After a good deal of preliminary inquiry and business negotiation, the directors of the North British Railway have resolved to adopt the electric light as the means of illumination for their new station at Queen-street, and within the last few days they have concluded a contract with Messrs. Crompton and Co. for the lighting of the station on the Crompton system. The order was only given ten days ago, yet by employing a portable apparatus similar to that just described, the contractors were able on Thursday night to light up the station so far as it is now completed, and with the most satisfactory results. The heavy passenger traffic consequent upon the fact that Thursday was the Edinburgh Fast Day was worked off with great ease and comfort to the railway officials, and the station master was most hearty in his congratulations upon the success of Mr. Crompton's energy and promptitude in meeting the emergency of the case. As many of our readers are doubtless aware, the St. Enoch Station has been lighted for some time with electric lamps made by the same patentee.

Among other important works recently carried out by Messrs. Crompton and Co., we may mention the lighting of the Alexandra Palace—building, park, and grounds ; the new waterworks near Skipton for the Bradford Corporation ; the celebrated Whiteley's, in Westbourne Grove, London ; the Stanton Iron Company's workshops, near Nottingham ; the works of the Hydraulic Engineering Company, Chester ; the Woodbury Type Establishment ; and in addition several sugar refineries, glass-works, and other industrial establishments.—*Glasgow Herald.*

PORTHCURNOW AMATEUR DRAMATIC AND MUSICAL SOCIETY.—The above society, which is composed of the members of the Eastern Telegraph Company's staff at Porthcurnow, gave their first entertainment for the season in the Lecture Hall, attached to the station, on Friday, the 29th October. It was announced for the 22nd, but the weather was so unfavourable that it was repeated the following week to a very good audience. Everything went off with the usual success, and for the interest of many members who are now at foreign stations we give a copy of the programme below :—Part I: Solo Pianoforte, Airs from "Traviata" (Madame Ouri), Mrs. R. E. Maunsell : quartett, "Farewell to the Forest" (Mendelssohn), Mrs. G. O. Spratt, Mrs. R. E. Maunsell, Mr. G. F. Withers, Mr. G. O. Spratt ; song, "The careful man" (Grossmith, jun.), Mr. G. W. Moss ; recitation, "The Battle of the Nile," from "Crescent and Cross," Mr. G. F. Withers ; song, "The Skipper and his Boy" (V. Gabriel), Mrs. G. O. Spratt ; duet, "All's Well" (Braham), Messrs. O. E. Richardson and G. O. Spratt ; song, "Terence's Farewell to Kathleen" (Lady Dufferin), Mr. R. E. Maunsell ; reading, "The Fogg Divorce Case" (Max Adeler), Mr. W. H. Ash ; song, "Hands together" (Van Landeghein), Mr. F. A. Wilkins ; chorus, "Harvest song" (W. Macfarren.). Part II. : Solo pianoforte, Irish air (Th. Oesten), Mr. J. W. Wetherell ; quartett, "Gentle winds around her hover" (Emanuel), Mrs. G. O. Spratt, Mrs. R. E. Maunsell, Mr. G. F. Withers, and Mr. G. O. Spratt ; song, "Hunting Song" (Whyte Melville), Mr. G. W. Moss ; reading, "Dame Fredegonda" (from "Bon Gautier" ballads), Mr. J. H. Adair ; song, "Mermaid's Song" (Haydn), Mrs. G. F. Pescod ; trio, "O ! happy fair" (Shield), Mrs. G. O. Spratt, Mrs. R. E. Maunsell, and Mr. G. O. Spratt ; song, "Take it Bob" (A. Lloyd), Mr. G. F. Withers ; reading, "I'm not a single man" (Hood), Mr. R. E. Maunsell ; song, "The Stirrup Cup" (Arditi), Mr. O. E. Richardson ; chorus, "Men of Harlech" (Welsh Air).

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ABSTRACTS OF SPECIFICATIONS.

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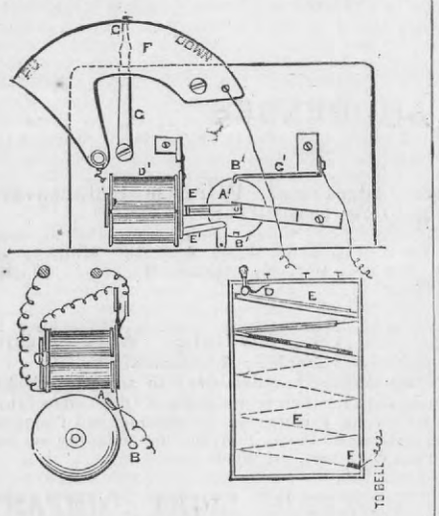
[*We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts*—ED. *E.*]

1212. ELECTRICAL FIRE ALARMS, *C. E. Spagnoletti.—Dated 20th March*, 1880. 6*d*.

The inventor has for his object the early advising of the chief depôt or local district depôts of the locality of a fire. A train of clockwork is started by the current that sends the signal of the fire and the locality of the alarm. A bell is used to give the alarm, its hammer having an earth connection to discharge the line wire. A^1 is a wheel on which are formed slots B^1 into which spring C^1 takes. This wheel is actuated by the ordinary telegraph instrument, and during its revolution the contact of the wheel between the slots is maintained with spring C^1, and the instrument is kept working; D^1 are coils which set the instrument in motion when armature E^1 is brought in contact, F is a quadrant, which with



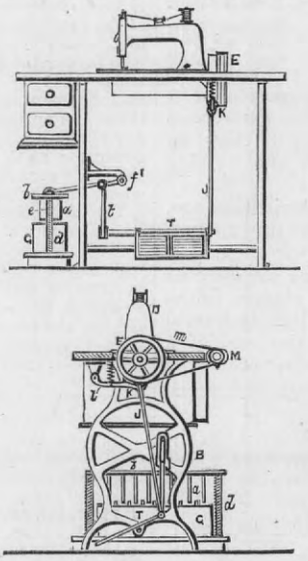
pointer G shows when the instrument requires winding. To the bell for calling attention when alarm is given is applied the spring A, which has an earth connection, so that as the bell is struck the part B comes against A, and the line wire at each stroke is discharged. In the third figure is shown a box with graduated slopes or planes; on spring D being raised it allows a ball to roll down the slopes, space being allowed for the ball to fall from one slope to another. In its course, by running over the metal lines E, the necessary indications are given. On arriving at F a bell is connected up to receive an acknowledgment signal. The claims are (1): The spring arrangements on the bell connected to earth, to discharge line. (2) The arrangements of graduated slopes or planes acting in connection with ball, or balls, or wheels, for the transmission of signals. (3) The automatic arrangements for starting receiving instrument.

1239. COMPOSITION AS SUBSTITUTE FOR INDIA RUBBER, *E. Quin.—Dated 23rd March*, 1880.—(*Not proceeded with*). 2*d*.

Chloride of sulphur is mixed with bisulphide of carbon or naphtha, or other volatile neutral solvent, and when perfectly mixed it is poured into a chamber with a good bodied oil. The whole is allowed to stand till the volatile matters have in great measure evaporated, when it is ready for use.

1244. REGULATING ELECTRO-MAGNETIC MOTORS, &c., *J. H. Johnson.—Dated 23rd March*, 1880.—(*A communication.*) 6*d*.

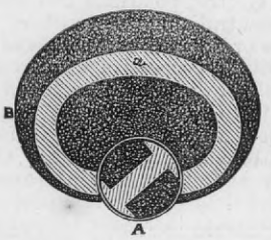
This invention relates to the regulation of the speed of electro-magnetic motors, the object of the invention being to obtain a delicate regulation of the motor without waste of the electric current. This object is obtained by combining with the motor and battery or generator devices controlled by a treadle for regulating the extent of immersion of anodes and cathodes in their liquid. The application to an ordinary sewing machine is described. The table of a machine is supported on the end frames, B, and carries a sewing machine, D. On the driving shaft of the machine is the pulley, E, over which passes a belt, M, from the shaft of the electro-magnetic motor of any desired construction. The battery, G, from which the motor derives its powers is supported on a platform, this battery consisting of a number of cells into which dip the battery plates, *a*; these plates are carried by a horizontal bar or plate, *b*, which is supported by spiral springs, *d*, or vertical guide rods, *c*. To the top of this plate, *b*, is pivotted



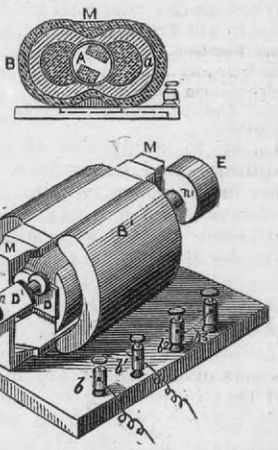
an arm or lever hinged at F^1 to some fixed part of the frame, and to this arm is hung a rod or cord, *t*, connected to a projecting pin on the treadle T. By depressing the treadle the lever will be caused to depress the bar *b*, carrying the battery plates against the action of the springs, *d*, so as to depress the said plates into the exciting liquid in the cells, and thus generate an electric current, which sets the motor in operation. The inventor claims (1) The combination of a cell or group of cells containing the liquid, positive and negative plates, and a lever connected thereto for regulating their immersion with devices for automatically removing the plates from the liquid, when the said lever is released, all substantially as hereinbefore described. (2). An electro-magnetic motor, positive and negative plates, devices for immersing the plates in and for automatically removing them from the liquid in combination with braking mechanism constructed to act in conjunction with the automatic device for raising the plates, substantially as hereinbefore described.

1259. ELECTRO-MAGNETIC MOTORS AND DYNAMO-ELECTRIC MACHINES, *J. H. Johnson.—Dated 24th March*, 1880.—(*A communication.*) 6*d*.

The main object of this invention is so to construct an electro-magnetic motor or dynamo-electric machine as to utilise the free magnetism distributed over the magnet as well as that concentrated at the poles. Also to utilise the induced currents in the coils, and the construction of the magnet and armature. One of the main features of the invention relates to the construction of the electro-magnets, and will be best understood by reference to the diagram, Fig. 1, in which A represents the revolving armature. This armature may be a magnetic armature of any ordinary construction, and in the drawings is shown one of the well known Siemens armatures, consisting of a bar having two opposite longitudinal grooves, in which are wound the coils of wire, the two ends of the latter being connected to the armature on the end of the bar. The core *a* of the magnet B, as illustrated in Fig. 1, is made of a form which may be said to represent a tube, the continuity of which is interrupted by a longitudinal slot extending from end to end of the tube, and in this slot a rotating armature, A, is so arranged that while the poles of the magnet are on opposite sides of the armature, in line with its axis, the entire body of the magnet with its poles shall closely envelop or surround a portion of the rotary armature in the direction of rotation, as shown in the drawings, the object being to so construct the magnet that all its parts will be as near as practicable to the armature, so that all parts of the magnet will exert their maximum effect, and the helices are arranged in such a manner as to exert their full force upon one another. It is not absolutely essential to make this so-called "tube" of a regular cylindrical form, it being sometimes convenient to make it in pieces, which give it an irregular or even rectangular shape. For practical purposes it is preferable to construct the motor or machine with a double magnet, as shown in Figs. 2 and 3, A being the above-mentioned rotary armature, and B, B^1 the electro-magnets, D the brushes of the commutator, and E the pulley for transmitting the power. The core of each magnet is made of the form described above with reference to Fig. 1; that is to say, each magnet must be of such a form as to practically embrace a portion of the armature in the direction of rotation, so that while the opposite poles or polar extensions of each magnet shall be on opposite sides of the



armature in line with its axis the entire surface of the wire covering of the magnet, with its polar pieces, will closely envelop a portion of the armature whilst at the same time permitting free rotation of the latter within the magnets and its poles. An advantage due to the use of a magnet of approximately semicircular form, such as illustrated in Figs. 1 and 3, is that well known curvature of the lines of force extending from one pole to the other of a straight magnet will, in the semicircular magnet, be reduced to approximately straight lines upon the inner side, where the armature is arranged. The main lines of force of the armature being also parallel and rectilinear in the Siemens armature they will cut the lines of force of the field magnets in the best possible direction. The claims are (1) in an electro-magnetic motor or dynamo-electric machine, the combination of a rotary magnetic armature with a magnet or a pair of magnets, having its or their opposite poles on opposite sides of the armature



in line with the axis of rotation, whilst the entire body of the magnet or of each magnet in connection with its poles closely envelops or surrounds a portion of the armature in the direction of its rotation; (2) an electro-magnetic motor or dynamo-electric machine, in which a rotary armature is combined with a pair of electro magnets, steel magnets, or common iron magnets of such form as practically to surround the armature with an uninterrupted field of iron or steel. (3) An electro-magnetic motor or dynamo-electric machine in which a rotary electro magnetic armature is combined with field magnets, having the ends of their wires electrically connected to each other for the purpose of utilising the induced current; (4) in an electro magnetic motor or dynamo-electric machine, the combination of magnets with a rotary armature, whose bar or bars is or are Z shaped in section; and (5) the combination of the motor with devices for suspending the same, whereby the said motor may be made to assume any desired position.

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	—	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	Victoria Docks.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Canea.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia..	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael...	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart ...	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Nov. 3.		Business Done Week Ending Nov. 3. Highest.	Lowest.
Anglo-American Ordinary	62,	¼	62⅝	60⅞
Do. "B"	92¼,	¾	94	91
Do. "A"	32⅜,	⅝	32⅞	30¾
Brazilian	9⅝,	10	10⅛	9 11-16
Cuba	8¾,	9¼	9¼	8¾
Do. Ten per Cent. Pref.	16,	½	—	—
Direct Spanish	3,	½	3¼	2⅞
Do. Ten per Cent. Preference	12¼,	12¾	12⅜	12¼
Direct United States	11 13-16,	15-16	12⅛	11⅝
Eastern	9¾,	⅞	9⅞	9⅝
Do. Six per Cent. Debenture	103,	106	104½	104½
Do. Five per Ct. do. 1899	102,	105	106	106
Do. Six p Ct. Pref	12½,	¾	12⅝	12⅝
Eastern Extension	10,	⅛	10⅛	9 15-16
Do. Six per Ct. Deb	108,	111	—	—
German Union	9⅜,	10½	9⅞	9⅞
Globe Telegraph & Trust	6¾,	⅞	7	6⅝
Do. Six p Ct. Preference	12,	½	12⅝	12
Great Northern	10⅛,	⅜	10¼	10⅛
Indo-European	24,	25	24½	24½
Mediterranean Extension	2⅜,	3½	—	—
Do. Eight p Cent. Pref	10¾,	11½	—	—
Reuter's	11,	½	—	—
Submarine	245,	255	245	245
West India and Panama	1½,	⅝	1 5-16	1 5-16
Do. Six per Cent. 1st Preference	6½,	7	6⅝	6½
Western and Brazilian	8⅛,	⅜	8¼	8 1-16
West. Union 7 p. Ct. 1st Mt.	118,	122	—	—
Do. Six per Ct. Sterg.	103,	105	104¾	104¾

TRAFFIC RECEIPTS FOR OCTOBER, 1880.

Companies.	Oct., 1880.	Oct., 1879.	Incrse.	Decrse.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,100 estd.	3,512	—	1,412
Direct Spanish Telegraph Company	1,821	1,370	451	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	47,570	50,251	—	2,681
Eastern Extension Telegraph Company	29,061	31,419	—	2,358

THE "JAMIN" PATENT ELECTRIC LIGHT
COMPAGNIE GENERALE D'ECLAIRAGE ELECTRIQUE.
Capital 8,000,000 francs.
Proprietors of the Gramme Patent Machine for alternate currents.
J. A. BERLY, C.E., A.S.T.E., &c., Engineer and Sole Agent for Great Britain and the Colonies, 16, New Bridge-street, London.

TO AMATEURS.—JOHNSTON and COMPANY'S NEW PRICE LIST contains everything necessary for EXPERIMENTS with Electricity, Electrotyping, Plating, &c., and will be sent post free on application.—121, Wardour-street, London, W.

INSULATED COPPER WIRE, Silk, Cotton, or India-rubber covered. Conductivity guaranteed. German Silver Wires for Resistance. Braided Handled Cord, Silk Cord for Electric Bells, &c.—J. and W. RICKARD, Insulated Wire Manufacturers, Ashbourne-road Mills, Derby.

ADDRESSES.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

W. T. GLOVER and Co., Insulated Wire Manu-facturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manu-facturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

HOOPER'S TELEGRAPH and INDIA RUBBER WORKS, MITCHAM and MILLWALL DOCKS.
Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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Works: Silvertown, Essex; Persan Beaumont, France.

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CABLES.—Submarine, Subterranean, and Aërial.

WIRE.—Insulated with India Rubber and Gutta Percha, to all gauges.

INSTRUMENTS.—"Morse" Inkers, Single Needle, Wheatstone's Alphabetical, Preece's, and Walker's System of Semaphore "Block" Instruments, Bells, Resistance Coils, Sir W. Thomson's and other Galvanometers, Condensers, Testing Instruments, Indicators for domestic use, Electric Bell Materials, &c.

BATTERIES.—**Sole Manufacturers for Great Britain, Ireland, and the Colonies of the celebrated Silvertown Improved Leclanche and Poggendorff Bichromate Batteries.** All other kinds of Batteries also manufactured. Ebonite Cells, Carbon Plates, &c.

The Leclanché is the best Medical Battery.

INSULATORS.—Ebonite, Porcelain, Brownware, &c.

ELECTRIC LIGHTING.—Electric Lamps, Gramme's Dynamo-Electric Machines, and Metallised and Ordinary Carbon Rods for Electric Lighting.

Manufacturers of the most Improved Apparatus for RAILWAY BLOCK-SIGNALLING.

SEMAPHORE REPEATERS, "LIGHT" INDICATORS, and WALKER'S PASSENGER-AND-GUARD COMMUNICATOR.

TELEGRAPH STORES AND APPARATUS OF EVERY DESCRIPTION.

TORPEDO APPARATUS.

The Company are Patentees and Manufacturers of a Complete System of Torpedoes for Harbour and Coast Defence, and of the

SILVERTOWN PATENT FIRING BATTERY.

A Constant Battery for Mining and Blasting Purposes.

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CONTRACTS ENTERED INTO for the SUPPLY, CONSTRUCTION, and MAINTENANCE of TELEGRAPH LINES, and ESTIMATES GIVEN for ALL KINDS of ELECTRIC HOUSE BELL WORK.

TELEGRAPH CONSTRUCTION and MAINTENANCE COMPANY (Limited).—SECOND BONUS TRUST.—Notice is hereby given, that the ELEVENTH DISTRIBUTION on the Certificates, issued under the Trust Deed of the 12th March, 1875, will be made on and after the 1st November, 1880. The distribution, which arises from dividends on the shares held by the Trustees, will be at the rate of 3s. per £5 Certificate, and the amount will be paid two clear days after presentation of Coupon No. 11 at Messrs. Barclay, Bevan, and Co.'s Bank, No. 54, Lombard-street.

Notice is also given, that supplementary sheets containing six coupons (numbered from 7 to 12, both inclusive), may be obtained by such holders as have not already procured them upon production of the respective Certificates, at 38, Old Broad-street, London, E.C.

By order of the Trustees,

D. KINGSFORD, Secretary to the Trust.

No. 38, Old Broad-street, E.C., 26th October, 1880.

ESTABLISHED 1851.

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Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.

The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.

The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.

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FRANCIS RAVENSCROFT, Manager.

31st March, 1880.

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HOW TO PURCHASE A HOUSE FOR TWO GUINEAS PER MONTH, with immediate Possession and no Rent to pay. Apply at the Office of the BIRKBECK BUILDING SOCIETY.

HOW TO PURCHASE A PLOT OF LAND FOR FIVE SHILLINGS PER MONTH, with immediate possession, either for Building or Gardening purposes. Apply at the Office of the BIRKBECK FREEHOLD LAND SOCIETY.

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ELECTRIC LIGHT: its Production and Use. By J. W. URQUHART, C.E. Edited by F. C. WEBB, M.I.C.E., M.S.T.E., &c.

"An interesting volume."—Mining Journal.

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CROSBY LOCKWOOD & CO., 7, Stationers' Hall-court, London, E.C.

EQUITY and LAW LIFE ASSURANCE SOCIETY,
18, LINCOLN'S INN FIELDS, LONDON, W.C.
CAPITAL, £1,000,000, FULLY SUBSCRIBED.

The most stringent tables have been used in valuing the Society's liabilities. Lapsed Policies are revived within the period of three months upon payment of the overdue premium and a small fine, without evidence of health. Whole-World Licences will be granted in most cases without payment of extra premium. Nine-tenths of the profits are divided among the assured every five years. At an extraordinary general meeting held on June 9, 1875, the sum of £844,379 was set aside as the value of the Society's liabilities under its Assurance and Annuity Contracts, and £173,180 was ordered to be divided as bonus; leaving a balance of undivided profit of £20,033. Nine-tenths of the sum divided was allotted among holders of policies for £2,500,000.

TABLE OF THE TOTAL ADDITIONS MADE UP TO DECEMBER 31, 1874, TO POLICIES OF £1,000 EACH.

Ages at Entry.	NUMBER OF PREMIUMS PAID.					
	Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	——	——	787 10 0	517 0 0	310 10 0	137 10 0

G. W. BERRIDGE, *Actuary and Secretary.*

NOTICE OF REMOVAL.

EDWARD PATERSON,

TELEGRAPH AND ELECTRICAL ENGINEER,

3, BEDFORD COURT, COVENT GARDEN, W.C.,

Will on and after the 1st May, 1880, REMOVE to

76, LITTLE BRITAIN, ALDERSGATE STREET, E.C

The Gower-Bell Loud Speaking Telephone.

TELEPHONE LINES ERECTED and MAINTAINED.

EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.

Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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SLIP

THE SOCIETY OF ARTS.—Mr. W. H. Preece will lecture on the Photophone on 1st December.

TELEPHONE EXTENSION.—Telephonic communication is successfully carried on between Manchester and Liverpool.

SIMPLE LESSONS.—A series of simple lessons will be commenced either in the first or an early number of our new volume.

THE LORD MAYOR.—Mr. M'Arthur, M.P., is one of the most esteemed directors of the Eastern Extension Telegraph Company.

QUEEN-STREET STATION, GLASGOW.—Three of Mr. Crompton's electric lamps are found to be sufficient for the purpose of lighting this station.

PHYSICAL SOCIETY.—At the meeting this afternoon Professors Ayrton and Perry will read some "Notes on Professor Exner's Paper on Contact Electricity."

SOCIETY OF TELEGRAPH ENGINEERS.—The meeting of the 24th inst. will be devoted to the Photophone, the President, Mr. W. H. Preece, taking charge of the subject.

CAPE TELEGRAPHS.—Telegram received at the Colonial Office from Cape Town, and dated 3rd November, reports:—"Telegraph wire still down, and believed to be severely damaged."

TELEPHONIC.—Stuttgart, the capital of Wurtemburg, is about to be provided with a complete system of telephonic communication by the International Bell Telephone Company. —*La Lumière Electrique.*

THE DISTRICT RAILWAY.—The electric light is now in use at the Charing Cross station of this line, and arrangements are being made to use it permanently, not only at Charing Cross but at Victoria and Earl's Court.

THE ELECTRIC LIGHT.—We understand that the Great Western Railway Company are seriously considering the question of the electric light for Paddington station, and that the Brush system is likely to be employed.

CHATHAM.—The dockyard is to be lighted by means of the electric light, and it is probable that two, if not three systems will be tried side by side for a period, in order to fully determine the one best adapted for the purpose in view.

CHESS MATCH BETWEEN LIVERPOOL AND CALCUTTA.—A chess match is now being carried on between the leading clubs in these two places—the moves being arranged by telegraph. A code is used so that one word indicates the moves.

THE LONTIN LIGHT.—The Eastern of France Railway Station is now lit up by this system of electric lighting, which, after trial in the goods station, has also been adopted in the passenger station of the Lyons and Mediterranean Company.

THE TELEPHONE IN POLITICS.—The President of the French Republic has established in his study a telephone apparatus, enabling him to have instantaneous communication with the Presidents of the Senate and Chamber and all the Ministers.

SUGGESTION OF THE PHOTOPHONE.—Mr. J. Munro draws our attention to the fact that in our contemporary, *Nature*, for 1878, p. 169, there appeared a short letter, signed "J. F. W.," and written from Kew, June 3, suggesting the principle of Professor Bell's photophone.

OZONE.—Some interesting facts relating to the liquifaction of ozonized oxygen under pressure were recently brought before the French Academy of Sciences. The gas assumes an azure blue colour, the shade deepening as the pressure increases. It was shown also that ozone is an explosive gas, since, unless compressed slowly and at low temperature, it exploded with a yellow flame.

NICKEL PLATED LOCOMOTIVES.—The Plating Company, of the Bishopton-lane Works, Stockton-on-Tees, are nickel plating the domes, valve covers, and other bright parts of seven locomotive engines for an English railway. This is something new in this country, but it will probably be in general use, as the finish is not only handsome, but the saving in labour and stores, such as oil and waste, is considerable.

THE ATLANTIC CABLE SCHEME.—We understand that the £20,000 necessary for the final sealing of the concession by the Portuguese Government, as referred to in two previous issues, was *not* paid on the day appointed, but that a further time has been allowed to December 4, to see if the money is forthcoming. We shall be extremely surprised if the whole affair does not turn out to be merely a ruse to act on the share market.

"HORSE-POWER."—An American has invented a new kind of stable floor which, among other things, will, he thinks, be useful for driving dynamo-electric machines. The floor is an endless band of transverse "slats," and when one end is lowered the horse paces upwards, and keeps the floor rolling. A pulley attached to the roller conveys this one horse-power to anything you please. When a suitable horse has been invented this machine will be perfect.

ELECTRIC SIGNALS FOR RAILROADS.—A system of automatic railway signalling, is, says the *Scientific American*, on view at the Cincinnati Industrial Exposition. Each section of a mile of track is insulated from that preceding and following it. How this is accomplished is not stated. A permanent current connected with a semaphore is maintained on each section; any displacement of the rails or the breaking of a bridge will interrupt the circuit and exhibit "danger."

GATESHEAD.—At their last meeting the Town Hall Committee reported that, in order to enable the inhabitants of Gateshead to form a correct estimate of the value of the system of electric lighting as patented by Mr. J. W. Swan, a member of their Town Council, and also to test the suitability of its use in the permanent lighting of open spaces, Mr. Swan had, at the request of the Council, consented to allow four of his lamps to be exhibited in front of the Town Hall, the committee to provide the electric power, to pay all expenses incurred, and to render to Mr. Swan such other assistance as he might require.

ELECTRIC LIGHT IN BELGIUM.—A new electric lamp has been brought out at Brussels by MM. Clerk and Bureau, engineers. It consists of a piece of marble or granite with holes in it, down which the carbons slide, but cannot, on account of the shape of the holes, fall through, the arc being formed between the points which come through the granite. It is said to be very successful, and under trial with a Jablachkoff light gave equal to 100 Carcel burners as against 40 for the Jablochkoff candle. It takes about two horse-power for a lamp equal to 100 Carcel burners, and the lamp will burn for twenty hours without any adjustment.

THE INTERNATIONAL CONGRESS OF ELECTRICIANS.—M. Georges Berger, who was the Director-General of the foreign sections of the Exposition in 1878, has been appointed Commissioner-General for the Congress of Electricians, and for the Exhibition connected with it. The Minister of Posts and Telegraphs will be the president, and six vice-presidents will

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be chosen from the members of the Congress, three from the French, and three from the foreign members. The Palais of the Champs Elysées is placed at the disposal of the Commission gratuitously, the cost of organisation and management of the exhibition, however, to be borne by them.—*La Lumière Electrique.*

Aurora Borealis.—According to the *Aberdeen Journal* of the 8th inst. a remarkable display of auroræ was witnessed in that neighbourhood between 6 p.m. and 9 p.m. on Wednesday week last. Two complete belts of bright light spanned the sky stretching from north-east to south-west, resembling an outer and inner rainbow, and remained stationary and unbroken for about an hour. At the same time the usual dusky cloud appeared in the north surmounted by a large space of white light from which now and then rays shot forth reaching nearly up to the belts, the outer and brighter one of which crossed the constellation of Lyra. The evening was clear and frosty.

The Anglo-American Company.—We should have given any shareholder more credit for business acumen than the instigator of the subjoined letter, which was given in the money column of a daily contemporary:—"Sir: Referring to the recent correspondence with reference to the interim dividend announced by the Anglo-American Telegraph Company, we beg to inform you that we have received instructions, on behalf of a holder of deferred stock, to commence immediate proceedings with reference to the payment of any such dividend, and further to restrain the payment of any further dividends until the capital represented by two of the cables which are said to be lost be replaced.—We are, sir, your obedient servants, Yewdall and Son, 3, King-street, Covent-garden, London, W.C., Nov. 1."

Constantinople.—We understand that Mr. J. Pender, M.P., the chairman of the Eastern Telegraph Company, who at present is visiting the stations of the company in the Mediterranean district, was admitted to an audience with the Sultan at Constantinople on Tuesday the 9th November. Although Mr. Pender's principal object during this tour is the business of the Eastern Telegraph Company, at the same time he must necessarily obtain a great amount of valuable information directly and indirectly upon political questions. The impression Mr. Pender formed during his long ($1\frac{1}{2}$ hour nearly) interview with the Sultan is that the ruler of Turkey has a strong desire to obtain an honourable settlement of pending questions, in order that he might give effect to a settled purpose of advancing the industrial and material development of the country.

A Proof that Money is Cheap.—The following actually appeared as an advertisement in a daily contemporary. We suppose the author could not get it inserted in one of the "comic" papers, and was so struck with his comicality that he was willing to pay to make it known:—Europe and America.—Telegrams Extraordinary.—Messages to be sent Gratuitously.—Capitalists, Investors, and other persons desiring to supply the mercantile community with this most pressing want, regardless of expense and without thought of profit, are invited to send their names and addresses to A. S. S. and Co., Stock Exchange, London, who contemplate forming a company for the purpose with a large capital and renewal fund. The latter will be provided out of the premium at which the shares will be issued. There is no time to be lost, as a company is expected to come out in a few days, offering a bonus to those who send messages over its lines.

The Canadian Cables.—The India Rubber, Gutta Percha, and Telegraph Works Company has recently completed the laying of cables between Anticosti and Gaspé, Bird Rock, and Magdalen Islands, and Magdalen Islands and Cape Breton. These cables were laid for the Dominion of Canada Government, Mr. F. N. Gisborne being the inspecting engineer on the part of Government, and Mr. King being in charge for the Silvertown Company. The ss. "Newfield," Capt Guilford, belonging to the Dominion of Canada Government, was employed in laying the cables. This ship was fitted with tanks, picking up and paying out gear, &c., at Silvertown, and will be employed in maintaining the cables, in addition to her regular duties in connection with the lighthouse and buoys department. The Silvertown Company seems to be obtaining now a very fair amount of cable work. The manufacture of the Mexican cable is rapidly progressing.

The Electric Light.—The British Electric Light Company (Limited), through Mr. H. Bury, their agent in Manchester, have introduced into the print room of Messrs M'Laren and Nephew's warehouse in George-street, a system hitherto practically unknown in that neighbourhood. Under Mr. Bury's superintendence there have been fitted up at Messrs. M'Laren's premises seven small divided lights, on what is known as the André system. Depending from the ceiling in lamp form, the lights are protected by glass globes, and fitted with reflectors, and their brilliant illuminating power is strikingly evidenced by the manner in which the various colours in the prints are shown up. Each light is said to be equal in power to six ordinary gas jets, and the system is held to be specially adapted for warehouses, printworks, steamers, billiard tables, dining and drawing rooms, and, indeed, any place where many small lights are required. The system has been introduced by the company in London and elsewhere, but this is the first occasion on which it has been shown in Manchester.

The Post Office and the Telephone Companies.—In this suit technically described as the Attorney General *v.* the Edison Telephone Company, and the Attorney General *v.* the Telephone Company, notices have been given to the parties to produce, for cross-examination at the hearing, the following witnesses, namely, for the Edison Telephone Company:—Edward Pleydell Bouverie, Arnold Henry White, Sir Wm. Thomson, George Gabriel Stokes, John Tyndall, John Hall Gladstone, George Carey Foster, John Ambrose Fleming, Baron Julius de Reuter, Robert Stevenson Symington, Baron Rayleigh, and John Hopkinson. For the Telephone Company:—James Brand, Wilfred Tudor Johns, Sir Wm. Thomson, George Gabriel Stokes, John Tyndall, John Hall Gladstone, George Carey Foster, John Ambrose Fleming, Baron Julius de Reuter, Robert Stevenson Symington, Baron Rayleigh, and John Hopkinson. For the Attorney-General:—Charles Henry Bennett Patey, Edward Graves, William Henry Preece, Robert Sabine, Cromwell Fleetwood Varley, William Ladd, Sir Charles Tilston Bright, Josiah Latimer Clark, David Edward Hughes, William Henry Barlow, Warren de la Rue, Sir George Biddell Airy, William Grylls Adams, Charles William Siemens, Stephen Mitchell Yeates, Amos Morony Vereker, William Spottiswoode, and Edward Alfred Cowper. Counsel for the Government are—The Attorney-General, the Solicitor-General, E. C. Simpson, W. Karslake, — Kaye, and J. Fletcher Moulton. Among the counsel on the other side are—Messrs. Benjamin, Horace Davey, Aston, Webster, and Hardy.

Fires at Telegraph Offices.—The newspapers have taken fright at the unfortunate occurrence which, as they describe it, had the effect of "isolating" a large and important city for some ten or twelve hours; and a terrible

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picture is drawn of what would befall us if the metropolis were to be similarly isolated by a fire at the Central Telegraph Office. The consequences would, no doubt, be inconvenient, especially to newspapers waiting for copy, and to the Post Office the expense would certainly be very annoying. But the general public would, we apprehend, bear the calamity for half a day without that heartrending agony which has been fancifully ascribed to them. The injury done at Manchester is fortunately not very great; but when we reflect that in few places are there collected together so many costly appliances as in a large telegraph office, and that most of them, if destroyed, could not be replaced except at immense outlay and loss of time, the accident is not without its lessons. No building yet devised can command entire immunity from fire; and as the only effectual casing for insulated wires would have to be not merely fireproof and damp proof but heat proof, the problem of perfect protection is not easily solved. Structural precautions, unceasing vigilance, and plenty of water are, of course, indispensable. In at least one of these respects the Manchester office seems to have been faulty. The lift acted as an excellent flue for carrying fire and smoke to every floor; and the proximity of the wires, though structurally convenient, was an error which will probably not be repeated elsewhere. One aspect of the question is certainly alarming. We have mentioned the possible destruction of apparatus. In view of such a disaster on a large scale we should feel greatly reassured by learning that the department has a reserve stock sufficient to make good the loss. Without this the public can never be safe from prolonged inconvenience which, if not heartrending, would be deplorable.

Solar Thunders.—"Light is the voice of the stars," saith the poet, with his divine instinct of truths, which modern science verifies by experiment. When Professor Bell announced his invention of the photophone, and showed how an intangible ray of light could be made to transmit audible speech and whisper secrets out of its golden silence, it was at once imagined that we might now be able by means of the photophone to listen at the beams of stars and suns and catch an echo, however faint, of the tremendous explosions and raging storms which disturb the surface of these incandescent worlds. As far as the stars are concerned the hope of ever being able to do this is very slight indeed; but the case is different with the sun, and according to the latest scientific intelligence from France, Professor Graham Bell, the inventor of the photophone, is actually engaged in experimenting to this end. Professor Janssen, the well-known astronomer, has kindly placed all the resources of the Observatory of Meudon at the disposal of the distinguished electrician, and has also undertaken to assist him. Thus far Professor Bell has confined himself to exploring an image of the solar disc by means of the photophone, but the results have not been very satisfactory, although they are such as to encourage him with the hope of ultimate success. The variations in brightness of the image due to disturbances at the surface of the sun are found to be too slow and faint to evoke distinctly audible sounds in the telephone of the photophone employed; but Professor Janssen has bethought him of a plan which will probably render the desired effect possible. He proposes to take photographs of the image on glass at intervals wide enough apart to give a considerable variation in the brightness and appearance of the photosphere or solar surface, and then by means of these photographs he will be able to project artificial images of the sun upon the photophone, following one another more rapidly than the actual direct images would have done. By this device the solar changes which occur will be condensed into a shorter space of time, and their effect upon the photophone more marked, just in the same way as the levels of a country are exaggerated by the sectional plans of the civil engineer. It is obvious, of course, that this method does not give a strictly scientific reproduction of the noises on the sun; but the idea of hearkening to the solar uproar is so beautiful in itself that its realisation in however imperfect a manner will be profoundly interesting.

Ten Years' Telegraphy.—A recent issue of *The Times* contained a long communication from a correspondent giving a *resumé* of the progress of telegraphy in this country since the date of the transfer ten years ago. It is becoming evident, says the writer, that Mr. Scudamore did not, after all, make so very bad a bargain when he purchased the property of the old telegraph companies. The event has proved that they had something really valuable to sell—something capable of great development; and even the price paid to some of the railway companies was not excessive when we consider the opposition which they might otherwise have offered to this great commercial and social reform. The writer then proceeds to quote from the last report of the Postmaster-General showing the increase in the number of offices where telegraph business is transacted since the acquisition of the system by the State. As regards this increase and its diminishing ratio in recent years, the writer falls into the error which we had occasion to correct some weeks ago. Mr. Scudamore's original intention was to have made every money order office also a telegraph office, but experience has shown that the requirements of the country even yet do not call for such an extension. The increased mileage of wire has been enormous. 5,600 miles of line, representing 49,000 miles of wire, were handed over by the companies; and we now learn that 23,000 miles of line, representing more than 100,000 miles of wire, are owned by the Department. To these must be made the substantial addition of 700 miles of submarine cables, as compared with 140 miles ten years ago. The number of instruments has increased from 2,200 to 8,150, of which 170 are Wheatstone's fast speed instruments compared with only four possessed by the companies. The introduction of duplex and quadruplex systems shows that new inventions have not been discouraged, and economy as well as efficiency have been promoted by the adoption of "sounders." The extension of the pneumatic system as an adjunct to telegraphy has been pushed forward as far probably as the service requires, London alone possessing over twenty-one miles of pneumatic tubing. *The Times'* correspondent advocates the application of this system to the delivery of messages which are in reality letters; but this is a postal and not a telegraphic matter. Turning to the financial results of ten years' government control, the revenue has increased from about half a million sterling to nearly one million and a half. It is estimated that the profit of the telegraph service for the current year will yield something like $4\frac{1}{2}$ per cent. on the entire capital expended. This result of shilling telegraphy brought about in the brief space of ten years must, the writer remarks, be admitted as satisfactory in the extreme; but he straightway goes on to say that "the public now ask for a cheaper service, and in so doing they but point the way to increased prosperity. Mr. Fawcett," continues this oracle of *The Times*, "has been placed at the head of the Post Office at a time when one branch of the service at least requires 'moving on,' and only the problematical (*sic*) result of a decreased revenue has deterred him from taking a bold step in this direction."

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CANTOR LECTURES.*

THE INDIA RUBBER AND GUTTA PERCHA INDUSTRIES.

BY THOMAS BOLAS, F.C.S.

LECTURE V.—DELIVERED FEBRUARY 30, 1880.

(CONTINUED FROM PAGE 293.)

The property of ebonite just illustrated may have a practical application in this way. It is often desirable to obtain quickly a reversed reproduction of a printing block, and this may be done in the following manner:—The block is forced against a sheet of ebonite, this being slightly warmed, so as to obtain a sunk impression; and the ebonite plate is next planed off level, or rubbed down by an abrading material, after which it is exposed to a heat of about 140 deg. Centigrade. The compressed lines now rise up and form a printing block, which is an exact reproduction of the original, only it is left-handed or reversed, and to fit it for printing it is only necessary to deepen the widely-extended whites by means of the ordinary wood engraver's tools. Ebonite forms very good printing blocks or stereotypes, these being made just as in the case of the soft rubber stamps (p. 787).

You see before you this evening a very fine collection of articles manufactured from ebonite, these not only serving to illustrate the manifold uses to which this material is applied in connection with the industrial arts, but also to exemplify the variations which may be produced in the material itself, as regards hardness and elasticity, by varying the composition of the original mixture in accordance with the principles already explained. In the case of specimens lent by the Silvertown Company you see a number of small articles of exquisite finish, and you will not fail to notice the collapsable drinking cup for travellers. Messrs. Cow and Co. have lent me two extremely fine specimens of vulcanite work, one being a what-not consisting of thick slabs of ebonite, supported by turned columns of the same material, and the other being an inlaid slab, built up of a kind of mosaic, formed out of variously coloured pieces of vulcanite, and you will notice that some of the pieces are nearly white. The conditions under which nearly white and coloured vulcanite can be obtained will be described further on. Mr. Falkenstein, of the Britannia Rubber and Kamptulicon Company, has brought me some admirable specimens. You will notice the thin ebonite sheet, almost like paper, which this firm manufactures, and also the extensive selection of fancy and ornamental articles, these being, for the most part, made after Mr. Falkenstein's own designs. Here is a reproduction of a medal which has been moulded in vulcanite by Messrs. Mackintosh, of Manchester.

Ebonite works very much like horn or ivory, and can be very readily turned at the lathe, but a high rate of speed is required. A finish can be given to the articles by the use of flour-glass paper, followed by the 000 emery paper used by watchmakers, after which a final polish can be rapidly given by the arrangement to be described. A number of rough pieces or discs of cloth are clamped, circular-saw fashion, on a spindle, and this is made to revolve at a very high rate of speed—say about 4,000 revolutions per minute. This polisher being slightly charged with fine brick-dust and water, oil, or paraffin, the articles to be polished are held against it, when they soon receive a high degree of polish. Rotten-stone may also be used on a polisher of this kind; and one considerable advantage attending the use of the polishing apparatus in question is the ease with which variously shaped articles may be operated upon. Small flat articles may be very readily polished by rubbing them on blotting paper charged with tripoli or rottenstone.

Many metals, especially iron, may be imbedded in soft ebonite and fixed very firmly by vulcanisation; and advantage is taken of this circumstance in many cases. Thus, the handles of steam and hot water cocks may be advantageously clothed with ebonite, and iron screws may be fixed into ebonite insulators in a like manner. Again india rubber rollers are usually fixed on to their iron spindles by means of a layer of ebonite placed next to the metal; the ebonite and the soft rubber adhering perfectly, while the ebonite adheres well to the iron, especially if the metal is somewhat toothed before the application of the soft material.

To give anything like a list of the applications of ebonite to the industrial arts would be impracticable, but its more important uses are illustrated by the specimens before you. The characteristic properties on which its usefulness principally depends are its hardness, elasticty, electrical non-conductivity, freedom from porosity, and its inertness towards most chemical products.

Vulcanite may be obtained in a coloured form by incorporating with it a large proportion of certain pigments, such as ultramarine, vermilion, sulphide of cadmium, sulphide of antimony, or oxide of chromium; while, if it is required in as nearly as possible a white state, oxide of zinc and sulphide of zinc may be used. When these pigments are incorporated there is not the same necessity for pushing the vulcanisation to such extremes as when rubber and sulphur alone are employed, as the pigments themselves give a certain degree of hardness. In such cases the proportion of sulphur, in relation to the rubber, may be very much reduced, and it is generally sufficient to carry on the curing to a point between the third and fourth stage, as already defined. At this point the rubber has a brownish or dark olive green colour, but the presence of a large proportion of pigment serves to mask this.

Dental rubber, the material used for setting and mounting artificial teeth, consists of a highly pigmented vulcanite, made to imitate the natural colour of the gums. There are on the table some very fine samples of the material in question, and for a portion of them I am indebted to Mr. Sangster, the representative of the New York and Hamburg India Rubber Company.

Dental rubber forms a very convenient material for the making of various small articles, and it may be readily cured in the small vulcanisers which were shown you on the occasion of the third lecture. (Figs. 20, 21, and 22, p. 209.) When it is desired to have a dental rubber which can be rapidly cured, the following composition will serve:—

Washed Borneo rubber	25
Vermilion containing 33 per cent. of free sulphur	30
Powdered sulphur	5
Sulphide of zinc	20
Sulphate of strontium	20
	—100

It is, however, better if colour and quickness of curing are not very primary objects, to approximate more nearly to the composition of ordinary ebonite. As for example:—

Rubber	45
Vermillion, as above	20
Sulphur	15
Sulphate of strontium	20
	—100

A small portion of fine gutta percha may be incorporated with the material for dental rubber, the result being advantageous in many cases; and shellac is occasionally added to the materials for ordinary ebonite.

The turnings and dust of ebonite may be compressed in hot moulds, so as to form buttons or other small articles, or these residual products may be mixed with new rubber and sulphur to form a second quality of ebonite.

When ordinary vulcanised rubber is heated to 230 deg. Centigrade, or until it melts, a permanently viscous product is obtained, and this substance, if mixed with emery and sulphur to a kind of paste, forms a material out of which the so-called agglomerated emery wheels or grinders may be formed, the mixed materials being next hardened or cured by the application of a steam heat. Emery wheels and hones made on this principle were introduced by Deplanque, about 23 years ago.

Thirty-five parts of old vulcanised caoutchouc having been placed in a kind of still, heat is applied to melt it, the operation being assisted by the gradual addition of about ten parts of heavy coal oil; but this latter is afterwards distilled off. The softened caoutchouc is then incorporated with 500 parts of emery of the required degree of fineness, and nine parts of sulphur. These materials having been thoroughly mixed, the bones or wheels are manufactured, and afterwards cured or baked at a heat of 140 deg. Centigrade, during a period of about eight hours. Grinding wheels, made in the above manner, can be worked at a speed of 2,000 revolutions per minute, and are extremely useful for the working of hardened steel or other obdurate materials. Some of the wheels, and also some knife sharpeners, are now on the table before you.

The substitutes for india rubber are of comparably little importance in relation to caoutchouc itself. Oxidised linseed oil is occasionally used in the making of flexible tubes for leading gas or for surgical purposes; indeed, I should rather say, for waterproofing such articles after they have been built up of fibrous materials. Such tubes, of which several specimens are before you, are far inferior to rubber tubes in most cases, and are formed by repeatedly varnishing the fibrous base with a carefully-prepared linseed oil varnish.

Vulcanised oil is, perhaps, of more interest, and many oils, such as linseed and others resembling it, may be vulcanised by being heated for some time to 150 deg. Centigrade with 12 to 20 per cent. of sulphur. The product obtained is soft, and somewhat resembles very bad india rubber. By increasing the proportion of sulphur very much indeed, say to four times the weight of the oil, and vulcanising at a higher temperature, a hard substance, resembling inferior vulcanite, is obtained.

Soft and hard vulcanised oil have been introduced into com-

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merce at various times and under many names, but these materials never seem to have made very much headway.

Various products, having pyroxyline or soluble gun-cotton as their basis, have been introduced as substitutes for hardened caoutchouc. Parkesine, a substance made by incorporating pyroxyline and linseed oil, forms a material well fitted for the manufacture of knife handles or similar articles; and I will now hand round a very beautiful specimen, which is well worthy of your notice.

The substance now known as celluloid, which consists essentially of pyroxyline and camphor, appears, however, to have characteristic properties which will enable it to fulfil certain purposes for which vulcanite is ill-adapted.

A solution, containing about equal parts of camphor and tetrachloride of carbon, dissolves or softens pyroxyline very readily, and if such a solution is incorporated with a sufficient proportion of the soluble nitro-cellulose, a dough-like mass is obtained, which hardens on the evaporation of the tetrachloride of carbon; but the material may be again made plastic and workable by being heated to a temperature between 100 deg. and 125 deg. Centigrade.

Many other methods of incorporating camphor with pyroxyline or nitro-cellulose may be adopted; as, for example, the mere mechanical admixture of the materials at a carefully-regulated temperature. Again, the camphor may be dissolved in carbon disulphide, liquified sulphurous acid, or other solvents. Celluloid may be, and often is mixed with resinous substances or colouring matters.

Another celluloid-like body, due to the ingenuity of Mr. Parkes, of Birmingham, is obtained by softening nitro-cellulose by means of alcohol, and forcing the product into moulds. This substance is exceedingly tough, while it has the advantage of being free from camphor, and is capable of resisting the action of heat to a considerable extent.

Celluloid and analogous products have the disadvantage of being very inflammable, and instances have been known of these bodies igniting by percussion.

Buttons, combs, billiard balls, and other similar articles are made of celluloid, the soft material being usually forced in iron or steel moulds. Most wonderfully perfect stereotypes may also be made of the material in question. Celluloid is also coming much into use for making artificial gums or bases for teeth.

EARTH CURRENTS.

The Secretary of the Great Northern Telegraph Company, in response to our suggestion that facts relating to earth currents should be noted and published for comparison, sends us the following, and remarks:—

"It is a pity that observations were not taken simultaneously on all telegraph stations where the disturbances were perceived in a systematical and uniform way, but is to be hoped that some rules may be given as to which data are the most essential and likely to lead to a satisfactory explanation of the origin and nature of earth currents."

Report from Nagasaki:

According to reports from Nagasaki the earth currents were for the first time observed on the Nagasaki-Shanghai cable on August 12th, at 7:45 p.m., Shanghai time (about 11:45 a.m. Greenwich time), and appeared on the receiving instrument as a zinc current, while it produced a deflection of about 10° on the galvanoscope, an ordinary, not very delicate deflector (giving a deflection of 3·6° for a current from 15 Leclanché's cells). At 8:24 p.m. a deflection of about 30° was observed at the Shanghai line, and almost simultaneously a deflection of 20° at the Nagasaki-Wladiwostock cable, which gradually fell back to zero, but from this time until about 10 p.m. deflections varying between 20° on both sides of zero were continuously observed at both lines; shortly after 10 the office was closed for the night.

The weather was calm all the time, and the barometer (holosteric) at 29·75 throughout the day; numerous falling stars were observed during the night, but no aurora borealis.

On the Japanese (government) lines the disturbing influences were felt as far as to Yezo, the northernmost of the Japanese islands; it was impossible to work between Sendai (38° 20′ N.) and Hakodate and difficult to work between Nagasaki and Yokohama.

Earth currents of greater or lesser intensity were also felt on the cables between the Chinese ports as far south as to Hongkay.

An observer on board the United States frigate "Ticanderoga," at Nagasaki, reports:—

"Last evening (the 12th), at 7, I observed a peculiar damping of my needles in amplitude to the north, also a slight vertical oscillation to my suspended vertical magnets. There was no wind blowing at the time, as I was seated in my room writing. I closed my air ports, and still observed the same. At 9:30 p.m. I made a note of many shooting stars, passing from N. to S., west of Zenita. Local terrestrial currents, I conclude, connected with slight tremor of earthquake, and the passage of numerous meteors from north to south, must probably have induced north-easterly currents or an increase of intensity in + induction."

Gothenburg reports:

On the cable lines from Gothenburg in Sweden to Newcastle-on-Tyne and Fredericia in Denmark no unusual earth currents were felt.

On the Gothenburg-Nystad (Finland) line, composed of about 323 n.m. land line and 96 n.m. cable, as well as on nearly all Swedish lines running east and west, the earth currents either totally prevented all correspondence or made it extremely difficult. The disturbances were considerable on the 12th between 12:30 p.m. and 3:45 p.m., were at their maximum at 1:30 p.m., and appeared in the wires as electrical charges, varying in strength and direction. The current was observed on the receiving instrument, on which the needle moved slowly from the one side of the paper to the other, passing zero as under influence from changing currents, and was at times of a force exceeding that from 200 Leclanché's cells. On keeping the line insulated for a moment, and then nearing the end of the leading wire to the earth terminal, brilliant sparks passed between them, while the leading wire was perceptibly heated so much even that the gutta percha commenced melting.

On the 13th similar disturbances occurred, but to a much smaller extent.

A FRENCH NOTE ON THE PHOTOPHONE.

At the recent meeting of the French Academy of Sciences, M. Antoine Breguet explained the photophone of Professor Bell, and M. Ch. Gros read a note recalling the fact that he had addressed to the Academy on May 20, 1872, a memoir published in part in the *Journal la Synthèse Médicale* (October, 1879), in which he was led by theoretic considerations to affirm *a priori* the results of experiments which seemed to him to present a remarkable analogy with those which had been that day communicated to the Academy by M. Breguet acting for Professor Bell.

The following is the principal passage in the article published in *La Synthèse Médicale* to which M. Gros alluded:—

To conceive the real mechanical action of light on matter it is necessary to return to the laws of the action of matter upon light, such as the laws of refraction, reflection, &c.

When light, in passing from one medium into another of different density (the media being separated by a surface oblique to the direction of the rays), *suffers* a deviation, we ought to conclude that if the medium *acts* upon it it *reacts* upon the medium. The universal mechanical principle of reaction permits me, therefore, to affirm that—

1. Light tends to reduce the density of the medium that it traverses to that of the medium from which it issues;

2. It tends to displace the transparent body in a direction opposed to the deviation which it suffers;

3. Finally, in the process of reflection, the reflected body suffers a recoil.

He suggested experiments upon these laws thus:

A. I would cause to enter into a tube reinforcing a note of n vibrations per second a ray of light interrupted and re-established n times per second. The alternative rarifaction and condensation of the gaseous medium would probably make the tube sound.

The radiant heat would be a source of error to eliminate or correct.

B. An apparatus analogous to the Colomb balance would carry, instead of the disc, a small mass of a transparent substance, very refractive. This mass would be equilibrated at the other end of the lever. The apparatus being very immovable, placed in obscurity or in a vacuum, I would make a ray of intense light pass across the refractive mass, and would observe if there was any sensible displacement.

It would be necessary to inquire if the partial reflection at the middle of the refractive surface would not make any obstacle to the mechanical effect.

C. To study the displacement by reflection it would be necessary to replace the refractive mass by a light mirror, always in vacuum because of the resistance of the air currents. [There is here a striking analogy to Crooke's radiometer.]

Also I would try to make a polished metal plate or a silvered membrane vibrate by a series of n flashes per second, this relation of the number to the time being determined by the vibrating body. These experiments, if successfully executed, would justly give a name to their author.

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THE ELECTRIC LIGHT.

The arrival of winter, with its short foggy days and long dark nights, has again brought the electric light into notice, and lectures, exhibitions of new lamps, and tenders for electric lighting are the order of the day. Its introduction into private establishments and public halls goes on as usual, and manufacturers, as well as railway directors, are beginning to wake up to its advantages.

The most recent installations of note are the new Siemens lamps in the British Museum reading room, the lighting of the Metropolitan stations on the south side, the great Brush light now being tried by the Admiralty, and the adoption of Crompton's lamp by the North British Railway Company for their new station at Queen's-street, Glasgow.

The new Siemens lamps in the British Museum are a great improvement on the old ones. They are completely enclosed in glass globes, so that there can now be no danger of red hot bits of carbon splitting off and falling upon the books and manuscripts below, endangering not only the volumes themselves but the whole library. The electric light was introduced into the British Museum partly because of its reputation as a safe light, and it would have been fatal to its use there if these burning sparks could not have been avoided. This, however, has happily been done in the new lamps, and the light is also much more steady now than formerly. The general effect is very fine, and there is now none of that disagreeable hissing and painful blinking which detracted from the service of the former lamps. At first the new lamps were surrounded by a screen of topaz-coloured glass, in order to quench the violet rays which sometimes tinge the whiteness of the arc; but the exceedingly jaundiced aspect of the light, and the cadaverous appearance of the readers thereby produced was, to say the least of it, depressing, and eminently calculated to induce suicide in the case of a bilious man of letters; so, for the benefit of civilisation in general, and English literature in particular, we are glad to see that the orange glass has been withdrawn. The gain to humanity must be considerable, for it is impossible to conceive of any brilliant ideas ever germinating in a light so wan and sickly. The silent manner in which the light seems to glide into existence in a moment, and illuminate the prevailing dusk as if by magic, is very beautiful, and convinces the most sceptical that for libraries, museums, and picture galleries, or, indeed, any place where the silence should be undisturbed in any way, the electric light is that to be preferred.

As regards the large Brush light now being tested by the Admiralty we have not yet much to say. The report of the engineers entrusted with the trial has not been published, and we prefer to wait until it has. The light itself is, however, of unusual brilliancy and penetrating power, as is requisite in a light required for naval purposes and torpedo work. It is reckoned to be of 47,000 candle-power, and is, therefore, perhaps, the largest single light ever produced. The carbon poles are $1\frac{1}{4}$ inch in diameter, and the wires conducting the current are $\frac{1}{2}$ inch in diameter. The Brush machine used in generating the current is the same as is employed for feeding sixteen ordinary Brush lamps. It is driven by an engine of 8 horse-power, working up to 14 horse-power, which is the power required for producing the light. As seen on the top of the works of the Anglo-American Electric Light Company, the new light presents a very splendid appearance.

Crompton's lamp has won golden opinions wherever it has been exhibited, and it is now undergoing the crucial test of actual use at the great terminus of the Glasgow and South Western Railway Company, St. Enoch's-square, Glasgow. Six lamps are there employed to light the vast area of the platforms, and they produce a very fair effect, much superior, of course, in clearness to the gas light which they have displaced, but slightly marred by the very black shadows thrown from the glazing frames of the lamps, the iron ribs of the roof, and so forth. These drawbacks are not the fault of the lamp itself, however, but the circumstances in which it has been placed. The success of Crompton's lamp at St. Enoch's, coupled with the fine effect it produced at the recent exhibition of gas and electric lighting apparatus at Glasgow, have decided the direction of the North British Railway to adopt it in their new station at Queen-street, where it has been fitted up. This fact is a notable triumph of the electric light over gas, for ere the Crompton lamp came upon the scene at the Glasgow exhibition it was reported in the daily papers that the North British directors were going to adopt Mr. Wigham's multiple flat flame gas lamps, such as are now to be seen at Charing-cross and Parliament-square, in London.

Mr. Crompton has devised a portable electric lighting apparatus, and we think this is a step in the right direction. Portable lamps cannot but prove useful for a great variety of purposes, such as facilitating building operations, or harvesting, or street paving by night. In a recent number of the *Globe*, Mr. J. Munro has drawn attention again to the old-fashioned habit kept up in London of paving the streets by day, when the work is an obstruction and a nuisance to the traffic and foot passengers, and allowing the whole night to pass unutilised, although the streets are free and unencumbered at this time. He further points out that the electric light has rendered such a course quite obsolete, and suggests that inventive electricians should devise a portable electric lighting apparatus specially suited to the work. Another line of improvement in electric lamps lies in the direction of their greater safety. The recent fatal accidents in Birmingham and on board the Czar's yacht "Livadia" show only too clearly that the dynamo-electric current is in some cases powerful enough to kill the strongest man by sheer rupture of his bodily tissues, and not merely by a sudden shock acting on a weak heart or nervous system. It behoves inventors,

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therefore, to turn their attention to the protection of their lamps from accidental or unskilled touch, to insulate the conductors and terminals in such a manner that a person however unskilled, using the lamp, need not incur the risk of death, unless indeed he wishes to. Electricians, in short, must not only strive to make their lamps successful but likewise safe. Mr. W. H. Preece has reiterated our arguments, in a recent letter to *The Times*, that electric lamps as now constructed are very unsafe in fiery mines, because a spark may be drawn from any part of the metal work conveying the current. Moreover, the red-hot carbon and the glowing arc are capable of igniting gas which has escaped.

The few instances we have cited undoubtedly prove that the electric lamp is gradually making its way into public service; but we should like to see it progress faster. One drawback to its advancement is the fact that the apparatus costs so much to begin with. Private parties hesitate to expend so much money in providing the engines, generators, and lamps. Even the fact that the working expense afterwards will be less than gaslight does not tempt them to make the initial outlay. It would, therefore, be a good thing for the success of electric lighting if large companies would undertake to supply a whole district with the electric current to their lamps just as the gas companies now supply gas, or the telephone companies telephones. Central stations will have to be established to generate the current by means of powerful machines, and distribute it to the lamp-owners of the surrounding quarter for so much per annum, or, better still, for the quantity of electricity consumed. In this way the inconvenience and expense of private machines will be saved to the public, and electric lighting will, we are sure, become far more general.

Another drawback to its progress is the lack of a very simple and, at the same time, very efficient lamp. All the lamps now in extensive use are more or less complicated, and they suffer in public estimation accordingly, for complication implies expense in the first place, and troublesomeness afterwards. A really good and simple lamp has yet to be invented, and a rich reward awaits the man who has the good luck to invent one. We say has yet to be invented, but we ought, perhaps, rather to say, has yet to be made public, for we have seen an experimental lamp which certainly bids fair to fulfil the two conditions we have indicated. Be this as it may, the arc lamps are better suited for large halls than private rooms, and it is still in the direction of incandescent lamps that we must look for general success in domestic illumination. Werdermann's lamp is one which must not be overlooked, and Mr. Joel's form of it is successfully installed in the fine new offices of Messrs. Latimer Clark, Muirhead, and Co. But all eyes are now turned to Newcastle, and every one is waiting to hear further about Mr. Swan's lamp. It is reported to be durable, and its beauty is unquestioned. If so, and the cost is what it is given out to be, there need be no fear for the future of electric lighting.

CORRESPONDENCE.

WHAT IS ELECTRICITY?

TO THE EDITOR OF THE ELECTRICIAN.

SIR: My letter to you of the 30th September was written with the object of getting Mr. Gordon to enter into a correspondence about the assertion in his book, "The cushions are connected with the ground so that the negative electricity produced on them can escape." His reply in your issue of the 16th October was virtually a refusal to enter into correspondence, but I am glad to find through his letter in your issue of 30th October that he has changed his mind, and has admitted that the passage in question is wrongly worded, and that he will amend it in the next edition of his book. This is just as it should be. An experimenter in, and writer on, science is looked upon as a false guide if he does not make the attainment of scientific truth the mainspring of his actions. Now that Mr. Gordon is following in the right course it is interesting to trace his views as to what he does regard as being the truth. The change he proposes to make in the second edition of his book on the above quoted passage is to remove the word "escape," and substitute for it the word "disappear." This proposal proves that Mr. Gordon is mentally in a state of great darkness as to wherein the passage is wrong. The error lies in his assumption, according to Dufay's two-fluid theory and Faraday's two-force theory, that there is formed on the cushions negative electricity, which is either to "escape" or "disappear" by a connection being made with the ground. This is wrong, the cushions take electricity from the ground, then deliver it to the glass, and the glass transfers it to the prime conductor. It is one electric fluid which passes through the machine. It is amazing that Mr. Gordon does not see that the passage in question commits him to Dufay's two-fluid or Faraday's two-force theories. The passage in question is far from being the only one in his book which commits him to being an upholder of one or other of these duplex theories, which are both wrong.

Again, Mr. Gordon writes in his last letter to you, "Let us attach a wire from the rubbers to the knob of a positively charged Leyden jar. Then, when we work the machine, the positive charge will be diminished. We may either say that some of the positive electricity has been drawn up the wire, or that negative has flowed down it, and neutralised some of the positive. We have no means whatever of distinguishing which is the correct view." If Mr. Gordon had read with attention your reprint of my letter of 1839, he would have seen that there was pointed out therein the means of determining the direction of a current of electricity. I shall now describe it more minutely. Let Mr. Gordon insulate a friction electrical machine entirely by placing vulcanised india rubber or blocks of paraffin wax below the base of it, and clothe the handle of it entirely with vulcanised india rubber. This will conserve all the electricity collecting power of the machine. Let him now take a copper wire from the rubbers to the ground, or still better to the water-pipe of his house. Let him now cut this wire in two near the machine, and place a small brass ball on each end of the wire where cut. Let him now adjust the two balls so that the distance between them is such as lets the electricity pass easily from the one to the other when the machine is in motion. Let him now place between these two brass balls a flame of gas well insulated by passing through a glass tube, and let the flame be free from smoke. If the size of the flame is properly adjusted so that the current of electricity has full power over the flame, he will find that whenever he sets the machine in motion and keeps it moving steadily the flame will bend down in one direction, and will never fluctuate backwards and forwards as a pith ball would do, but, on the contrary, it will always bend down in one direction, and this direction indicates the direction in which the current of electricity is moving. A pith ball is deceitful because it takes on a coating or charge of electricity, and therefore dances backwards and forwards. The insulated gas flame cannot receive a coating or charge of electricity, and therefore it does not fluctuate in its movements. Mr. Gordon will find it utterly impossible to get the insulated gas flame to indicate that a current of electricity ever goes from the rubbers to the ground. The flame always indicates that the current of electricity goes from the ground to the rubbers.

This establishment of the fact that no negative electricity accumulates on the rubbers requiring to be allowed to "escape" or disappear, demolishes Dufay's theory of two fluids and Faraday's theory of two forces.

There are some other very important matters in Mr. Gordon's last letter, but at present I refrain from making comments on them, because it is best in controversy to exhaust one subject before going to another. Will Mr. Gordon try the experiment of the gas flame and let you know if he can get it to indicate that a current of electricity goes from the rubbers to the ground?—

Yours, &c., JAMES JOHNSTONE.

Craiglockhart Hydropathic, near Edinburgh, Nov. 9, 1880.

HISTORICAL MEMORANDA ON SUBMARINE TELEGRAPHY.

BY F. C. WEBB, M.I.C.E., M.S.T.E.

(CONTINUED FROM PAGE 235.)

1852. On June 18th of this year a cable was laid by Messrs. R. S. Newall and Co. in the paddle-wheel ss. "Britannia" between

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Holyhead and Howth, Ireland. It consisted of a solid copper wire, of No. 16 gauge, covered with gutta percha to gauge No. 2, and closed with twelve No. 12 galvanised iron wires without any serving between the gutta percha and the iron wire. It was the first single conductor cable (for the Dover and Grisnez line was not a cable), and the only one that has ever been made without any serving. A few miles from each shore the cable had larger iron wires—about No. 6—so that this was the first cable with "shore ends."

This cable is notable also on account of its being laid by the first expedition in which the drum break was employed. This break consisted of a flanged drum six feet diameter, with a break strap acting on a part of the drum itself, separated by a flange from the part round which the cable took five turns. The knife or plough fleets the turns on the drum so as not to allow the feeding part of the cable to ride over the turns already on. These drum, strap and knife form the principal features in the breaks used at the present day. The placing of the strap on a separate drum to that on which the cable passes, the form of break strap (such as the Appold, which is not always adopted), the overhanging drum and the improvements in the means of adjusting the knife being certainly improvements, but which leave the main features of the breaks at present employed the same as those of the break used on this Irish cable. The drum strap and knife had been used for years in controlling wire ropes in working short inclines at collieries and works where empty waggons are pulled up by those that are loaded and descending, but the credit of first adapting this to submarine cable work was clearly due to Mr. R. S. Newall on this Irish cable, and is one of the most important steps in submarine telegraph engineering. Attempts to supersede the drum break on the 1857 Atlantic cable led to failure, and though the break of the 1858 Atlantic cable was sufficient to lay the cable it has never again been used, but the drum and knife break, with its various modifications and improvements, has been used ever since on all expeditions. Mr. Henry Woodhouse, C.E., and Mr. Spencer were engaged on this work with Mr. Newall. The cable failed in insulation soon after being laid, and was never recovered.

In October of the same year Messrs. Newall and Co. attempted to lay a cable for the Magnetic Telegraph Company from Portpatrick to Donaghadee. The cable was made at temporary works erected by Messrs. Newall and Co. near the North Dock, Sunderland. The cable consisted of five separate conductors of No. 16 copper, each insulated to No. 3½ B.W.G., served with Russian yarn soaked in Stockholm tar and tallow, and closed with ten No. 1 B.W.G. galvanised iron wires. In laying this cable the steamship "Britannia" was again employed, with the drum break as before. But the conditions were different; the cable was heavy, and the water deeper—about 180 fathoms instead of 80—and the tide stronger. The strain necessary to keep the cable from running out was much greater, and, a breeze of wind springing up, the ship was swung by the cable stern to tide and wind, and the cable had to be cut and abandoned when about sixteen miles of cable had been paid out. Its recovery was effected some years after, and will be noticed further on.

1853. The Dover and Middlekirke cable, commonly called "Ostend cable," very similar to the Portpatrick and Donaghadee cable, was laid in May. This cable had five No. 16, covered with gutta percha to No. 2, laid round a centre wire of No. 16, covered to No. 3½. The pressure of the other wires on the No. 3½ in the centre was supposed to account for a fall in insulation in this wire. The iron wires consisted of 12 No. 2, and these were not galvanised. This was, therefore, the first cable with *ungalvanised* outer wires. It was laid from the screw steamer "William Hutt." This was therefore the first cable laid from a screw steamer. The engines of the "William Hutt" broke down through the choking of the feed pumps, and the ship had to be taken in tow by the tug which Mr. Newall had provided for such contingencies. In the same year Messrs. Newall laid an almost similar cable, having six No. 16 wires, each covered with gutta percha to No. 2 B.W.G., between Portpatrick and Donaghadee, from the ss "William Hutt."

In this same year the first three of the four cables from Orfordness to Scheveningen, in Holland, were laid. Here the compound type of cable was departed from, as it was considered that there was less risk in laying four separate cables, which at that time was a consideration, seeing that the Dover and Calais had been laid with difficulty, and that the Holyhead and Howth had failed after laying, and also considering that the length (about 114 statute miles) was much greater than that of the other cables, either laid or making. The type was No. 16 copper wire covered with strong tape, and tarred and sanded. This was again served with yarn and closed with ten No. 8 B. W. G. galvanised iron wires. For shore ends it was determined to lay up together six of the main cables round a central insulated wire. At the sea end of these shore ends about 50 fathoms were left unlaid, and a seventh piece of cable was laid in, joined to the central wire. Thus there were seven tag ends to which as many main cables could be spliced after the shore ends were once laid. The shore ends were three miles long on the English and two miles on the Dutch shore.

In making this cable all welds were galvanised, and the iron wire was of the best charcoal. In order to test the cable in its entirety for insulation the author (who was then assistant engineer to the International Telegraph Company, for whom the cables were laid) urged the necessity of testing the whole cable under water, and this being sanctioned by Mr. E. Clark, the engineer, a dock was constructed by the author in the factory yard at Messrs. Newall's works at Sunderland, into which the cables were coiled. The soil was pure sea sand, the sides of the dock were made of timbering, planked, caulked, and tarred, and the bottom of concrete, covered with an inch of pitch asphalte. It held water perfectly, in spite of numerous prophecies to the contrary, and the cables, which were manufactured two at a time, were coiled into it, the water being kept level with the top flake. On Sundays the dock was filled, and a good test taken. These cables, as regards the history of testing, were, therefore, the first cables tested under water during manufacture. The cables were laid from the paddle steamer "Monarch," which ship was purchased by the Electric and International Telegraph Company, and became the first permanent telegraph cable repairing ship, commonly known as the "Old Monarch." The break and leads were fitted by Messrs. Newall, who had the contract for laying the cable. When the ship arrived off Orfordness to land the end Mr. Newall did not arrive, although his staff were on board. The concession for the cable would lapse on June 1, and after waiting till May 30 the expedition started, Mr. E. Clark taking the responsibility. The route had been carefully marked with flag-buoys at intervals of about 12 miles by Lieut. E. Burstal, R.N. In steering the "Monarch"—the duty undertaken by the author—bearings of the buoys either astern or ahead were constantly kept on, and to do this sometimes the ship had to be headed as much as 5 points from the course of the cable, as a full gale of wind sprung up which caused the London tug attending on the expedition to run for Harwich. The cable was, however, laid with engineering care, and no cable across the North Sea has, it is believed, since been laid with so little waste through drifting with the changing tide, the length of cable being 119 statute miles over 114½ length of route. This cable as regards laying may be noted on account of the systematic buoying of the course. When the Dunwich to Zandroot cable was laid in 1858 no buoys were employed. The distance is 122 statute miles, and 138 miles of cable were used. This is 10 miles more than the same per centage on the Hague cables, and as this was a compound cable, worth probably £600 a mile, the cost of the 10 miles would leave a handsome balance over the cost of buoying, and the resistance of the circuit would have been lessened by 10 miles.

The two main cables of this system were, on account of urgency as regards the concession, laid before the shore ends. The shore ends were afterwards laid, and the cable grappled up, cut, and spliced on to the tag ends which were permanently buoyed. The making of these shore ends entailed some trouble and ingenuity. The process was as follows:—Six one mile lengths of main cable from the Sunderland Factory were taken to Mr. Newall's works at Gateshead, where the only machine large enough to lay them up existed. The bobbins of this machine held half a mile each. When a half mile length had been laid up, the other ends were placed on the bobbins, and laid up. The one mile of complete cable was then sent by rail to the Sunderland factory and six tails, each half a mile long, spun on to each end of the complete one mile length. This was then taken to Gateshead, and these tail ends laid up, thus making a two mile length of complete cable. This was again taken to Sunderland, and the operation was repeated. The whole three mile length weighed about forty tons, and had to be coiled in a long coil on some seven or eight railway trucks.

The system of having four cables with single conductors instead of one heavy cable with four was not found to answer well on account of the lightness of the cables themselves (about 39 cwt. to the statute mile). The fishing smacks and colliers were constantly breaking them, and the cost of repairs was very great; but, on the other hand, as regards maintenance of the communication, during the four years the author had charge of the Hague cables the communication was not entirely cut off more than once, and that for only twelve hours; whereas during the same period communication by the Dover and Ostend and the Dover and Calais cable was several times entirely interrupted for several weeks together.

The constant breaking of these cables entailed the employment of the "Monarch" steamer, refitted out by the author, and during four years the system of grappling, picking up, buoying,

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&c., was organised by him, and it has been repeated and improved on various expeditions since.

The first drum picking-up machine was made to the author's designs for this ship.

ELECTRO-TELEDYNAMICS.

BY PAGET HIGGS, LL.D.

(CONTINUED FROM PAGE 148.)

For a first consideration of the subject, there will be more interest in approaching it from a point of view whence we can be accompanied by the practical engineer, for it is to him that promoters of the system of electro-teledynamics must bring the details in order that the system may have the full appreciation it merits.

The first question that arises usually in such discussions is—What size and kind of conductor will you use? Before giving a direct answer to this question let us ascertain what current an ordinary telegraph line will carry. And for this purpose we may select, as a most convenient size, an ordinary line-wire of No. 6 American gauge (= ·162 inch diameter) corresponding very closely to No. 8 Birmingham wire gauge (= ·165 inch diameter), and to the French 4 mm. wire. Calculated in C.-G.-S. units from the specific resistance of iron as 9827, this wire would have 2·4 ohms for 1,000 feet, or 12·65 ohms a mile; in practice, however, the resistance should be taken at 3 ohms for 1,000 feet.

There are two points to be determined—How rapidly the wire will become heated by a current? and how rapidly that heat will be emitted into the surrounding atmosphere? It is not at all advisable to push the heating to extreme limits, because this heat not only represents loss of work by loss of current in heating effect, but it decreases the capacity of the line by increasing the electrical resistance. Therefore, we must consider the temperature in the wire as to be not much above that of the surrounding atmosphere. It may seem unnecessary to dwell upon this point, but there appears to have been but little consideration given to it. Sir William Thomson even, in a hasty speech before the Institution of Civil Engineers, when this subject was under discussion in 1878, says: "The most practical way would be to put the wire in the shape of a copper tube. Having a copper tube, with a moderate amount of copper in its sectional area, and a current of water flowing through it, with occasional places to let it off and places to allow water to be admitted for the purpose of cooling, there would be, without any injury to the insulation, a power of carrying heat practically unlimited." One does not always have the good fortune to catch so great a philosopher tripping, but this statement has been so often quoted to me that I am compelled to point out that the heat carried away by the water is work carried away and lost (unless we use the water in our dwelling houses or in some equivalent way). Further, such a loss does not compensate in any equivalent gain; for, calculating the heating effect as work and as taking place in the circuit proportionally to the resistance of the various parts of the circuit, we cannot afford to lose heat (beyond a necessary quantity) in the inactive or line circuit.

It is requisite, then, to determine the emissive rate for the wire in question, and afterwards to ascertain the current that will generate only that quantity of heat the wire can emit under usual atmospheric conditions.

A thousand feet of the wire under consideration—and the consideration of a thousand feet will, for the same current, be the same as for a thousand miles—will have an emissive surface of 38,100 square centimetres. I have determined, by rough experimental means, although with sufficient accuracy for the purpose, the loss of heat from new and from old galvanised iron wire, and the results I have obtained differ, as far as I have carried my experiments, but little from those obtained for copper surfaces as described by Mr. D. M'Farlane in the *Proceedings* of the Royal Society for 1872 (p. 93). It may for all practical purposes be taken, for between 30° and 60°C. differences of temperature of the wire and the surrounding atmosphere, that ·0003 unit of heat is lost per second per square centimetre of surface for each degree of difference of temperature. The surface of the 1,000 feet of wire will, therefore, have an emission of 11·43 units of heat per degree of difference, and assuming the atmosphere at 64°F., or say 18°C., we may take conveniently a difference of 30°C., bringing our wire to a temperature of 48°C., or say 118°F. This will give us a rate of emission (including surface conduction) for heat of 343 units of heat a second; in other words, there is that quantity of heat emitted sufficient in one second to heat 343 grammes of water 1°C.

The specific heat of iron is, nearly enough for our purpose, 0·1—that is, an equal weight of iron would require one-tenth of the heat necessary to raise the same weight of water to a given temperature. As 343 units of heat (gramme-degrees) is represented by 11·43 grammes of water raised 30°C., the same quantity of heat would raise 114·3 grammes of iron to the same temperature.

But in the 1,000 feet of iron wire are 29,750 grammes of metal, therefore there are required 89,343 gramme-degrees to raise this wire to 30°C. above its normal or atmospheric temperature, and to maintain this temperature against the loss of heat by emission and surface conduction.

This wire has a resistance of 3 ohms, and we have to find what current in webers will produce on this resistance the required quantity of heat. We have the well-known simple equation $0{\cdot}2406\ C^2 R = H$; and having H given as 89,343 and R as 3, we find $C = 353$ webers.

The conclusion has been arrived at, by a somewhat round-about process it is true, that a common telegraph wire of No. 8 B.W.G. will convey a current of 350 webers with perfect safety and without appreciable heating effect.

THE SOCIETY OF TELEGRAPH ENGINEERS.

On Wednesday, the 10th November, the winter session of this society was inaugurated by a reception given by the President, Mr. W. H. Preece, at the rooms of the society, 4, Broad Sanctuary. The reception was to inaugurate the opening of the Ronalds Library as well as being the opening meeting of the session. This library is one of the most valuable possessed by any society, and the members ought to be highly gratified by such an acquisition. Many societies have struggled for long periods to obtain a library of a special nature with far less success than the Society of Telegraph Engineers. Great credit must be given to the librarian, Mr. A. J. Frost, for the admirable manner in which he has carried out the work of binding, arrangements, and cataloguing the books in the library. The visitors who crowded the rooms included some of the best known men of this and other societies. Among the attractions of the evening we noticed relics of Ronalds 1816 Telegraph, and of the late fire at Manchester, portraits, &c., of the older electricians, in addition to the great attraction of the books themselves.

Turning from electrical literature to electrical apparatus, a very remarkable telegraph instrument attracted much notice in an adjoining room. We have heard a great deal about the American Rapid Telegraph Company, and we had a brief opportunity of examining its special apparatus on this occasion. It is said that its ordinary speed in America is 1,000 words per minute, and in the presence of the society's members over 1,100 words were got through in 57 seconds—of course on short circuit. It is being tried, however, on the post office wires, and we were gratified to learn from Mr. Foote, who with Messrs. Randall and Anderson are the joint inventors, that the authorities had afforded every facility for testing the instrument's powers under the conditions which prevail in this country. To Birmingham it worked well, though not at the alleged speed attained in America. To Manchester its performance was not so good; and when tried to Glasgow we believe it did not surpass, if it equalled, the Wheatstone fast speed instrument. Induction is fatal to it on our long lines—at all events that is the case at present. The *modus operandi* of the American is the same as with English instrument; a slip is punched, and is then passed through an automatic transmitter. The point of difference is mainly in the manipulation of the currents—the reversals which with us are used for the separation of marks being utilised, in the later invention, for marking, only not in the same straight line. For example, the letter *h* is made by two positive and two negative currents, the marks appearing as two consecutively, and the other two on the farther side filling up the gaps. No space is wasted, therefore, except for the separation of letters and words; and of course the possible speed is enormously increased. The transmitting is accomplished by two platinum brushes corresponding to the action of the rocking pins of the Wheatstone, but in the American invention working currents flow from both contact points. The slip is very short, the signs very compact, and rapidly read by persons accustomed to the, to us, curiously displaced symbols. The slip is perforated at a keyboard, alphabetically lettered, the power in this instance being a treadle. The speed of this part of the arrangement is probably not at all greater than that of the English perforator, but it is considered simpler. It should be mentioned that the receiving slip is a chemically-prepared paper similar to the Bains'.

MR. SWAN'S ELECTRIC LAMP.—Mr. Swan will bring his new lamp before the Society of Telegraph Engineers on an early date—probably December 8.

THE GOWER-BELL TELEPHONE.—We understand that Her Majesty's Government have presented the Sultan of Morocco with a pair of the Gower-Bell Company's loud-speaking telephones.

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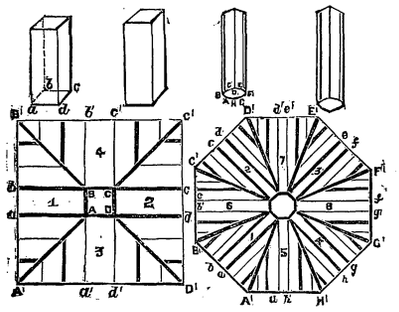
ABSTRACTS OF SPECIFICATIONS.

—o—

[*We are indebted to our contemporary The Engineer for the diagrams which illustrate these abstracts*—ED. *E.*]

1234. GALVANIC BATTERIES, *A. M. Clark.—Dated 22nd March*, 1880.—(*A communication.*) 1*s.*

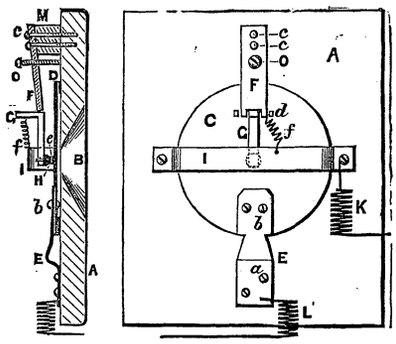
This invention of M. Regnier relates to improvements in the composition, preparation, and regeneration of the liquids employed in galvanic batteries, and to the manufacture of the porous partition. A description is given in *The Electrician*, July 10, 1880. The following is the formula for exciting liquids:—Water, 1,200 parts by weight; soda, 300; potash, 100; chlorate of potash, 20; chlorate of soda, 20; chloride of potassium, 20; chloride of sodium, 20; sulphate of potash, 20; sulphate of soda, 20. The depolarising liquid is composed of water 1,200 parts by weight; sulphate of copper,



240; nitrate of copper, 60; chlorate of potash, 20; chlorate of soda, 20; chloride of potassium, 20; chloride of sodium, 20; chloride of zinc (saturated solution), 20; sulphate of potash, 20; sulphate of soda, 20; sulphate of zinc, 20. The drawings show the mode of manufacturing the porous vase for the battery in the form of a square prism. The inventor makes nine claims relating to (1) the composition for the exciting liquid of a galvanic battery, containing, besides caustic soda, all or nearly all of the salts mentioned in the first formula; (2) the composition for the depolarising liquid of a galvanic battery, containing, besides sulphate of copper, all or nearly all of the salts mentioned in the second formula; (3) the preparation in a dry state, or in aqueous solution, of mixtures of all or most of the bodies other than soda mentioned in the first formula, for subsequent mixture with a solution of soda to form an exciting liquid for use in galvanic batteries; (4) the preparation in a dry state, or in aqueous solution, of mixtures of all or most of the bodies other than sulphate of copper mentioned in the second formula, for subsequent mixture with a solution of soda to form a depolarising liquid for galvanic batteries; (5) the processes of regenerating the exciting and depolarising liquids; (6) the manufacture of porous vases of quasi-prismatic form, without joins or seams, as described and illustrated; (7) the method of setting out and folding the porous vases, as shown and described; (8) the manufacture and employment of porous vases rendered less impervious in parts by the insertion of additional thicknesses of the same or different material; (9) the manufacture and employment of porous vases rendered partly impervious by immersion in paraffin, wax, or other substance, as described.

1286. TELEPHONES, *J. H. Johnson.—Dated 27th March*, 1880.—(*A communication*). 6*d.*

This invention relates more especially to improvements upon the patent No. 351, granted Jan. 27, 1880, rendering the instrument more simple. A is the front of an ordinary transmitter box, and B the opening leading to the diaphragm, C, which is in contact with a damping ring or shoulder, D, by means of a metallic spring arm, E, which is secured at one end by screws to the front piece, A, and by screws at the other end to the diaphragm. On the opposite side to this spring hinge is secured to the piece A a practically rigid metallic arm, F, which is fastened in place by screws *c c*. The free end of this arm is bifurcated or morticed, and in the mortiсed portion is pivotted by adjustable screw pivots, D D, a knee or metal angle piece, G, to the lower extremity of the vertical leg of which is secured a carbon button, H, which is kept in contact with the platinum point E in the centre of the diaphragm by the gravity of the horizontal leg of the knee. The claims are—(1) The carbon holder G pivoted to F; (2) in combination with G



and F, the bridge I and connecting wire *f*: (3) the arm F inclined towards the diaphragm and provided with an adjustable screw, O; (4) the combination, as illustrated, of C, E, F, G, and H.

1328. TELEGRAPHIC AND TELEPHONIC APPARATUS, *W. R. Lake.—Dated 31st March*, 1880. —(*A communication.*) 1*s.*

This relates to the giving of visible and audible signals by means of an electric circuit, and comprises, 1st, the combination of two or more instruments in the same circuit, each consisting of an electro-magnet with two or more armatures, and mechanism operated by the movement of the armatures, and so arranged that any one instrument can be so set as to sound a local alarm or signal without sounding the other alarms. 2ndly, the main wire is connected at the central office and at the several stations with a switch so constructed that when the telephone is in place the circuit is, through this switch, direct to the coils of the magnet in the calling instrument, and from these to the main line, the coils of each calling instrument being in the main line when the receiving telephones are all in place; but the act of taking the telephone from its holder cuts out the coils of the calling instrument at that station, the switch moving when the weight of the telephone is removed from it, so that the current is through the telephone to the main line instead of through the calling instrument to the main line. 3rdly, a secret system, whereby no telephone can be used until its calling instrument is properly set; and, 4thly, a central switch for connecting together any two or more of a large number of circuits. Claims: First, the signalling instrument having an electro-magnet with two armatures, both of which are moved by a heavy current, while but one of them is moved by a light current. Second, the signalling instrument with a notched disc and finger, the disc being revolved by the passage of the current, and the signal being given only when the notched disc is arrested so that the finger can enter the notch. Third, the signalling instruments with pawls and their wheels, and stops for arresting the motion of the said pawls when the said wheels are in certain positions. Fourth, a series of signalling instruments and a series of telephones in combination with a series of switches, the telephones being switched out of the circuit when the coils of the signalling instrument are switched in, and the coils being switched out when the telephones are switched in, substantially as above described. Fifth, the apparatus consisting in a series of calling instruments with a series of telephones, each telephone being cut out of the circuit until its instrument is set for calling. Sixth, the central switch. Seventh, in a signalling instrument for telephones the combination of the fingers, bridge pieces, hook, and the contact point arranged in combination with the main and local circuits.

1339. ROTARY INDUCTION OR ELECTRIC MOTOR, *J. C. Mewburn.—Dated 1st April*, 1880.—(*A communication.*)—(*Not proceeded with.*) 2*d.*

This consists, 1st, of a galvanometric frame, on which are wound a number of turns of one or more insulated electric wires. 2ndly, of the motor mounted on a pivot, and situated in the centre, at top or bottom, or in proximity of the galvanometric frame. It is formed of a piece of magnetic or magnetised metal, which is put into motion by the action of the current circulating through the spirals of the galvanometric frame; and, 3rdly, of magnets grouped in suitable position around the motor. Any of the ordinary motors are used. In order to put the motor into movement it is sufficient to send the induction current through the wire which covers the galvanometric frame. As long as the current flows the apparatus is caused to turn with a power, more or less great, in proportion to the power of the current, and of the magnets arranged around in suitable positions. The magnets may be replaced by electro-magnets. To obtain the maximum effect it is necessary that not only the position of the magnets but also their power be calculated in accordance with the power and the nature of the current which circulates through the spirals of the galvanometric frame. The direction of the motion can be reversed either by changing the order of the poles of the magnets or by changing the direction of the current. The invention therefore consists in employing the rotary action directly engendered by the passage of an interrupted current in the presence of a piece of magnetic or magnetisable metal capable of moving around an axis or centre; it comprises applications of this principle both as a motor intended to produce power and as an experimental or scientific instrument. In the latter case the motive part may be enclosed in a glass or other vessel full of air, or full of liquid, or exhausted of air.

1343. PRODUCTION AND APPLICATION OF ELECTRICITY AND MAGNETISM, *I. L. Pulvermacher.—Dated 1st April*, 1880. 8*d.*

This consists, first, of chain batteries, comprising a number of elements connected together, such batteries being capable of acting when in an open position or when rolled up. Each element is composed of a copper cylinder with a longitudinal slot, and holes for the access of the exciting liquid to the element, as well as for the circulation of air, and stamped in other parts to form ears to form the articulation of the links. The upper part of the cylinder receives in the interior a small cylinder end, formed from a plate rolled up and having a projecting ear, through which and also through the outer cylinder ears passes a pin. Each element is provided with zinc in the interior, which is set in voltaic contact with the neighbouring element, and is of gutter form, with a strip of fibrous material between its two arms; secondly, of a portable plate battery of circular form in which plates of copper are placed alternately with plates of zinc, a space intervening. All the plates have perforation with tongue pieces, by which they are secured to a disc of vulcanised fibres, and their edges are turned down and grasp a piece of felt or cloth. Two such appliances are placed next against each other, an insulating disc being interposed, and the zinc of one being placed next to the copper of the other. A central rod connects the two; and, thirdly, of voltaic bands fitted with fastening appliances similar to those described in specification lodged 30th March, 1880, such fastening being formed of the electro metals, zinc and copper, placed alternately on bands of cloth, or within the garment next to the skin. The specification also describes accessory appliances, one of which is designed to modify the intensity of the current according to requirements. It is composed of a cylindrical hollow vessel of insulating material, provided with a bottom and a cover or cap mounted in a water tight manner on the threaded tube. The outside surface of this cylinder is screw-threaded, and into the screw thread is laid or wound spirally from one end to the other a very thin wire of German silver, or of an alloy of silver and platinum, one end of which is attached to a point on the cylinder, and the other end is placed in conductive connection with a metal wire from one pole of a battery. The outer edge of the screw thread formed on the cylinder receives a thick metal wire wound spirally from one end to the other of the cylinder, one end of which is free, whilst the other end is placed in conductive connection with a wire from the other pole of the battery. In order to obtain greater resistance than the thin wire in the grooves can afford, the hollow cylinder contains a screwed rod which screws in the threaded nut fixed in the centre of the cap. On the outer extremity of the central rod is a knob by which the rod may be turned, the said rod having on its inner extremity a disc of the inner diameter of the tube. The disc is provided with holes which allow a resisting-giving liquid, for instance, a mixture of glycerine with water, to traverse them when it is moved up and down in the cylinder by means of its screw thread, thus making the disc at a greater or less distance from the metallic bottom of the cylinder. When the disc is caused to approach the bottom by turning the screwed rod the minimum of resistance is attained by the layer of liquid between the disc and the bottom, while if, on the contrary, the disc is caused to approach the cap, the maximum of resistance will be produced.

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THE BRITISH CABLE FLEET.

Company.	Ship.	Gross Tonnage.	H.-P. Nominal.	Captain.	Where Employed.
Eastern Extension	ss Agnes	781	99	G. R. Sims	Singapore.
Telegraph Construction	ss Calabria	3,325	300	—	Victoria Docks.
Henley's	ss Caroline	526	70	—	North Woolwich.
Eastern	ss Chiltern	1,304	200	W. Goodsall	London.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss Dacia	1,856	170	Hayward	Algiers.
Telegraph Construction	ss Edinburgh	2,315	275	J. Seymour	Victoria Docks.
Siemens'	ss Faraday	4,908	500	A. Wilkie	Millwall Docks.
West India and Panama	ss Grappler	868	100	E. Cole	West Indies.
Eastern and South African	ss Great Northern.	1,352	130	A. H. Richardson	Mozambique.
India Rubber, Gutta Percha, and Telegraph Works Co.	ss International	1,155	110	—	Silvertown.
Eastern	ss John Pender	1,213	98	W. Perkins	Suez.
Telegraph Construction	ss Kangaroo	1,773	160	A. Killett	Victoria Docks.
Anglo-American	ss Minia	1,986	250	S. Trott	Halifax, U.S.
Canadian Government	ss Newfield	785	90	R. A. Guildford	Canada.
Western and Brazilian	ss Norseman	1,372	200	W. H. Lacy	Bahia.
Paris and New York	*ss Pouyier Quertier	1,385	160	Husson	St. Pierre-Miquelon
Eastern Company	ss Retriever	459	80	W. J. A. Dunn	Canea.
West Coast of America Telegraph Company	ss Retriever	624	95	H. Benest	—
Telegraph Construction	twin screw Scotia	4,667	550	W. R. Cato	Victoria Docks.
Telegraph Construction	ss Seine	3,579	500	H. Manning	Victoria Docks.
Eastern Extension	twin screw Sherard Osborn	1,429	200	F. Worsley	Singapore.
Submarine Telegraph Company	Lady Carmichael	—	—	—	Dover.
H.M. Indian Government	Patrick Stewart	1,130	130	W. Bishop	Persian Gulf.

* This vessel sails under the French flag.

TELEGRAPH SHARE LIST.

Companies.	Closing Prices Nov. 10.		Business Done Week Ending Nov. 10. Highest.		Lowest.	
Anglo-American Ordinary	61⅛,	2½	62⅜		61⅛	
Do. "B"	91⅛,	2¼	92⅝		91⅛	
"A"	32,	¼	32⅝		31⅛	
Brazilian	9 13-16,	15-16	10		9¾	
Cuba	8⅜,	9½	9 15-16		9	
Do. Ten per Cent. Pref.	16,	⅓	—		—	
Direct Spanish	2⅞,	3⅛	3 3-16		3	
Do. Ten per Cent. Preference	12½,	¾	12¾		12½	
Direct United States	11 13-16,	15-16	12		11¾	
Eastern	9 11-16,	15-16	9⅞		9⅝	
Do. Six per Cent. Debenture	103,	106	—		—	
Do. Five per Ct. do. 1899	103,	105	106		106	
Do. Six p Ct. Pref	12⅛,	¾	12⅝		12⅜	
Eastern Extension	9 15-16,	10 1-16	10⅛		9⅞	
Do. Six per Ct. Deb	108,	110	109⅝		109⅝	
German Union	9¾,	10¼	10⅛		9⅞	
Globe Telegraph & Trust	6⅝,	¾	6⅞		6⅝	
Do. Six p Ct. Preference	12,	¼	12⅜		12	
Great Northern	10⅜,	⅝	10⅝		10⅛	
Indo-European	24,	25	25		25	
Mediterranean Extension	2¾,	3¼	3		2 13-16	
Do. Eight p Cent. Pref	10¾,	11½	11		11	
Reuter's	11,	½	11		10½	
Submarine	250,	260	257		254	
West India and Panama	1½,	½	1 7-16		1⅜	
Do. Six per Cent. 1st Preference	6½,	7	6⅝		6½	
Western and Brazilian	8,	¼	8¼		8	
West. Union 7 p. Ct. 1st Mt.	118,	122	—		—	
Do. Six per Ct. Sterg.	104,	107	105		105	

TRAFFIC RECEIPTS FOR OCTOBER, 1880.

Companies.	Oct., 1880.	Oct., 1879.	Increase.	Decrease.
Anglo-American Telegraph Company	—	—	—	—
Brazilian Submarine Company	—	—	—	—
Cuba Submarine Company	2,100 estd.	3,512	—	1,412
Direct Spanish Telegraph Company	1,821	1,370	451	—
Direct United States Telegraph Company	—	—	—	—
Eastern Telegraph Company	47,570	50,251	—	2,681
Eastern Extension Telegraph Company	29,061	31,419	—	2,358
Great Northern Telegraph Company	—	—	—	—
Submarine Telegraph Company	—	—	—	—
Western and Brazilian Telegraph Company	—	—	—	—
West India and Panama Telegraph Company	—	—	—	—
West Coast of America Telegraph Company	—	—	—	—

A Military Line.—The signal service has just completed a transcontinental military telegraph line from Bismarck, Dakota, to Dayton, Washington territory. It crosses the Rocky Mountains by Sohon Pass, over the Mullane road.

The Block System.—In regard to the block system, the Chicago *Times* of the 25th says: "A test operation of this system, as erected by the Union Electric Signal Company, will be made on the Chicago, Burlington, and Quincy road on Friday, Oct. 29. A special train with the invited guests will leave the Chicago depot at 11 a.m. of that day, and will return in the afternoon. The system already erected protects about 13 miles of track. It is entirely automatic."

The Central Office.—The following is an abstract of an article on the Postal Telegraph Department at St. Martin's-le-Grand which appeared in the *Daily News* under the title of "Titanic Telegraphy." No two of the sectional telegraph offices throughout the metropolis are in communication with each other save through the medium of the Central Authority at St. Martin's-le-Grand. From the twenty principal offices the collection of messages is carried on by pneumatic tubes, which not only save time and trouble, but guard against error as the telegram is delivered precisely as it is written. The pneumatic tubes stand out from one of the walls of the instrument-room, looking not unlike the pipes of a gigantic organ. There are for the metropolis forty tubes, each office requiring one for despatch, and another for receiving, resembling large cartridges. Two engines of 500 horse-power supply compressed air. The message, or a dozen messages as the case may be, is enclosed in the cartridge-like case made of strong india rubber coated with felt, a slide is pulled open, the cartridge placed in the pipe, pressure is turned on, and the message is already well advanced on its journey. The pipes are worked on the block system, no fresh message being inserted till the arrival of the previous despatch is announced. Most of the stations with which the pneumatic tube is connected are close at hand, such as Threadneedle-street and Gresham House. Up to within a very recent period the furthest extension was to the office at West Strand. More lately a tube has been carried as far as the House of Commons, though it is only working when the House is in session. The journey to Charing-cross is performed in four minutes, whilst it takes seven minutes for the messages to travel to or from the House of Commons. The tubes are by inside measurement from 2½ to 3 inches in diameter. They are made of lead, laid in an ordinary cast-iron pipe. At first wrought-iron pipes were used, but it was found that lead answered the purpose much better. The pressure supplied is from 12 to 15 pounds to the inch. Messages received for foreign parts are passed on through the tube, the appropriation of the respective amounts due to the English and foreign services being subsequently arranged by the Clearing House. It is said that foreign telegraphists who visit St. Martin's-le-Grand hold pneumatic tubes connecting sub-offices with head-quarters to be a somewhat costly device; but, considering the saving of skilled labour, a pecuniary saving is probably effected, and there is no question that the public gain considerably by this auxiliary. The pneumatic tubes are also used for conveying messages in the immense instrument room from one instrument to another. During the last year the increase in the work was 20 per cent., at which rate of growth it will be doubled by the year 1885. The needle instrument is worked only in connection with small offices, having been supplanted by the Morse, which is at work at most of the tables. The punchers for the automatic instrument are operated by compressed air. By this system messages can now be despatched at the rate of 200 words a minute. Duplex is now commonly worked, and in many cases quadruplex, even on wires serving as many as four towns. A single wire with four clerks has dealt with 215 messages in an hour. The office frequently deals with 50,000 *messages* a day, and has despatched within the same time a million *words* of news. This excellent work is accomplished by a staff of about 1,450, all told, of whom 500 are girls. Eight hours a day is the measure of work required from each. The tide of population in the great room gradually rises each day till noon, at which hour it reaches its flood, and begins to decrease till midnight, when the regular night staff (all men) come on. The girls earn from 10s. to 30s. a week, whilst lads begin at 12s. a week, and when they have grown to man's estate may, if they are exceptionally skilful, earn as much as £160 a year. To the casual visitor the population of this great room seem happy and contented, a content which, on the whole, is shared by the public, who at once support and profit by the labours of this admirably administered department of the State.

The Nautical Magazine.—The current number of this monthly contains several interesting articles dealing with telegraphic and electrical matters. The first is a paper by Sir Travers Twiss "On Submarine Telegraph Cables," dealing of course with the question of International law on this subject. We hope to reprint this paper in our next issue. There is then the continuation of an article "On Compasses and their Adjustment in Iron Ships;" and Mr. Thomas Dobson, M.A., of South Shields, contributes an article entitled "Apparatus for illustrating lessons on the Deviation of the Compass in Iron Ships."

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ADDRESSES.

*** NOTICE.—It has been decided to devote a portion of the advertising space of *The Electrician* to giving the addresses and specialities of the principal firms of Electricians, Engineers, &c. A moderate charge per annum will be made for the insertion of such addresses weekly, and firms desirous to be included in the list are requested to apply to the Manager, 396, Strand. The addresses must not occupy more than five lines.

PHILLIPS BROS., Electrical Wire Manufacturers, MACINTOSH-LANE, HOMERTON, LONDON.
Specialities—Gutta Percha, India Rubber, Compound, Cotton, Silk, Flexible Cords, Telephone Wire, &c., &c. Multiple and other Wires. Special Wires for Dynamo Machines. Electric Light Leads, &c.

W. T. GLOVER and Co., Insulated Wire Manufacturers, 25, BOOTH-STREET, MANCHESTER.
Works: 4, BRIDGEWATER-STREET, BROUGHTON-RD., SALFORD.
Specialities—Insulated Iron, Copper, and G. P. Wires, in Silk and Cotton, for all descriptions of Telegraphic, Telephonic, and Electrical Work. Specially covered G. P. Wires for Leading-in, &c., and Iron Wires for Overhead Work.

THE BRITISH ELECTRIC LIGHT COMPANY (Limited), 41, PARLIAMENT-STREET, WESTMINSTER.
Sole Licensees for the well-known Gramme Electric Lighting Machine. Contractors for the supply of Electric Light on all approved systems.

MARSHALL, SONS, and Co., Limited, Britannia Works, GAINSBOROUGH, and 3, KING-STREET, CHEAPSIDE.
Specialities—Portable and Fixed Engines specially adapted for Driving Electric Light Machinery.

PETER BROTHERHOOD, Engineer, 56 and 53, COMPTON-STREET, GOSWELL-ROAD, E.C.
Specialities—Patent 3-Cylinder Engines (Silver Medal, Paris), as used by Siemens, Gramme, and Wilde for driving Electric Machines.

RANSOMES, SIMS, and HEAD, Orwell Works, IPSWICH.
Specialities—Portable and Stationary Engines, fitted with patent governors, as tried in the electric lighting experiments on the Thames Embankment.

ABBOTT and Co., NEWARK-ON-TRENT.
Specialities—The "Standard Size" Vertical Cross Tube Boilers. Illustrated catalogue, giving every detail of a variety of Boilers, 2s. 6d., post free.

CARBON ELECTRODES COMPANY. Works: 39, COMMERCIAL-ROAD, EAST.
Specialities—Carbon Rods of all sizes for Electric Lighting. Also, Plates and all other Moulded Carbon Goods. List of prices on application.

M. THEILER & SONS, Telegraph Instrument Manufacturers, 86, CANONBURY-ROAD, N. Works: ALWYNE-LANE, N.
Specialities—Morses, Polarised Relays, Saunders' Curb Keys. Makers of the BEST TELEPHONE TRANSMITTER (Theiler's Patent).

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Contractors for the Manufacture and Laying of Submarine Telegraph and Torpedo Cables. Manufacturers of Hooper's celebrated Insulated Core. Printed reports on application. Offices: 31, LOMBARD-STREET, LONDON, E.C.

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The most stringent tables have been used in valuing the Society's liabilities. Lapsed Policies are revived within the period of three months upon payment of the overdue premium and a small fine, without evidence of health. Whole-World Licences will be granted in most cases without payment of extra premium. Nine-tenths of the profits are divided among the assured every five years. At an extraordinary general meeting held on June 9, 1875, the sum of £844,379 was set aside as the value of the Society's liabilities under its Assurance and Annuity Contracts, and £173,180 was ordered to be divided as bonus; leaving a balance of undivided profit of £20,033. Nine-tenths of the sum divided was allotted among holders of policies for £2,500,000.

TABLE OF THE TOTAL ADDITIONS MADE UP TO DECEMBER 31, 1874, TO POLICIES OF £1,000 EACH.

Ages at Entry.	NUMBER OF PREMIUMS PAID.					
	Thirty.	Twenty-five	Twenty.	Fifteen.	Ten.	Five.
30	£685 10 0	£549 0 0	£434 10 0	£290 10 0	£175 0 0	£78 10 0
45	841 0 0	678 10 0	533 0 0	353 10 0	211 0 0	93 0 0
60	——	——	787 10 0	517 0 0	310 10 0	137 10 0

G. W. BERRIDGE, *Actuary and Secretary.*

ESTABLISHED 1851.

BIRKBECK BANK.—Southampton Buildings, Chancery Lane.
Current Accounts opened according to the usual practice of other Bankers, and Interest allowed on the minimum monthly balances when not drawn below £25. No commission charged for keeping Accounts.
The Bank also receives money on Deposit at Three per Cent. Interest, repayable on demand.
The Bank undertakes for its Customers, free of charge, the custody of Deeds, Writings, and other Securities and Valuables; the collection of Bills of Exchange, Dividends, and Coupons; and the purchase and sale of Stocks and Shares.
Letters of Credit and Circular Notes issued.
A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
31st March, 1880.

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A Pamphlet, with full particulars, on application.
FRANCIS RAVENSCROFT, Manager.
Southampton-buildings, Chancery-lane

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NOTICE OF REMOVAL.

EDWARD PATERSON,
TELEGRAPH AND ELECTRICAL ENGINEER,
3, BEDFORD COURT, COVENT GARDEN, W.C.,
Will on and after the 1st May, 1880, REMOVE to
76, LITTLE BRITAIN, ALDERSGATE STREET, E.C
The Gower-Bell Loud Speaking Telephone.
TELEPHONE LINES ERECTED and MAINTAINED.
EXPERIMENTAL WORK OF ALL KINDS CARRIED OUT.
Catalogue of Electric Signals, with 150 Illustrations, post free six stamps.

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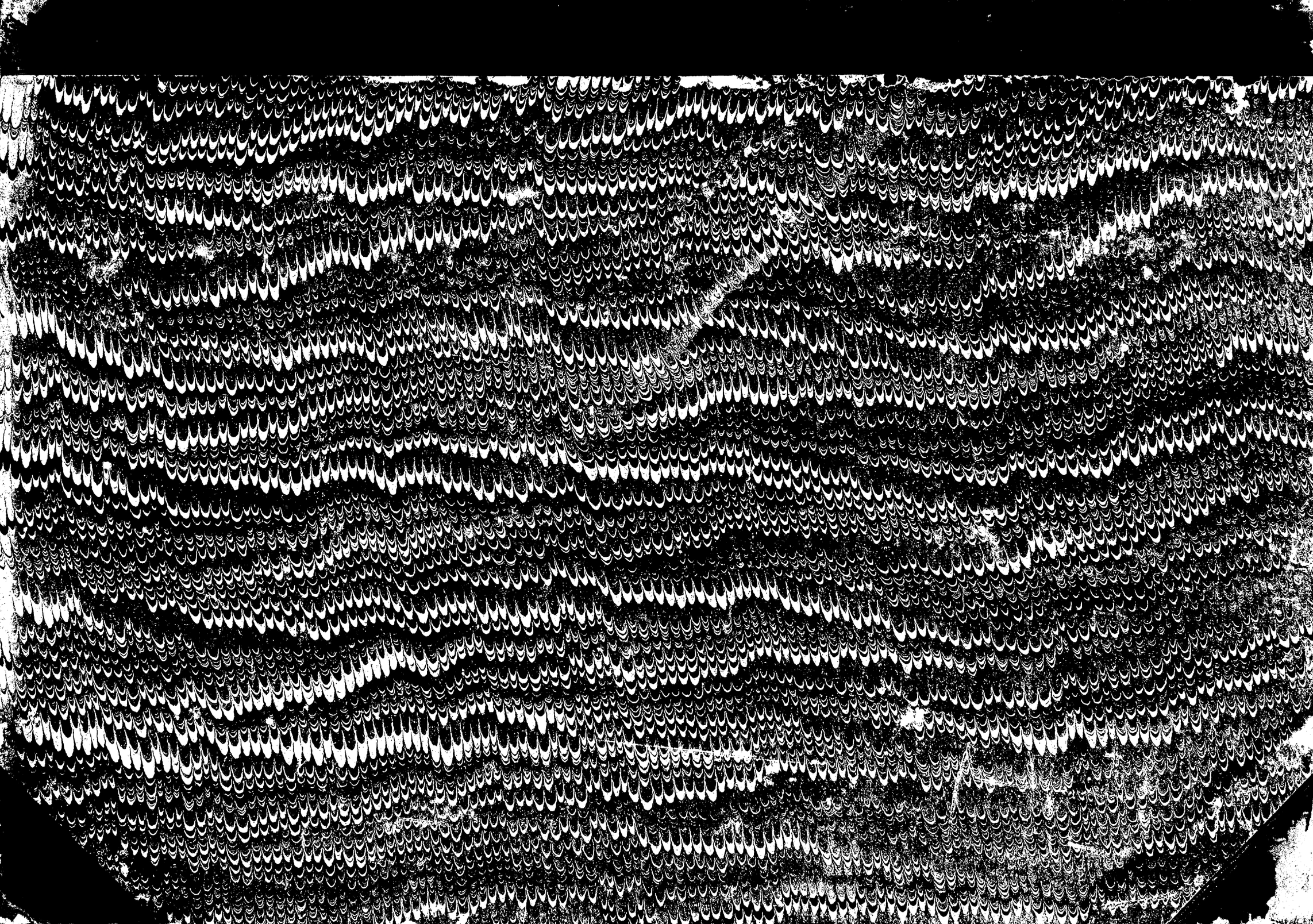
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